1989

ANNUAL REPORT

ALBERTA SPECIAL CROPS AND HORTICULTURAL RESEARCH CENTER

Alberta
AGRICULTURE

1989 ANNUAL REPORT

ALBERTA SPECIAL CROPS AND HORTICULTURAL RESEARCH CENTER

BAG SERVICE 200
BROOKS, ALBERTA
CANADA TOJ OJO

TELEPHONE: (403) 362-3391

91-02435/

TABLE OF CONTENTS

DIRECTOR'S REPORT 1

ADMINISTRATIVE SERVICES SECTION 3

SITE OPERATIONS SECTION 5

HORTICULTURAL CROP PRODUCTION SECTION 7

- Potato Program 8
- Vegetable Program 10
- Fruit Crops Program 13
- Ornamentals Program 16
- Greenhouse Crops Program 18

SPECIAL CROPS AND AGRONOMY SECTION 21

- Special Crops Program 21
- Field Crops Program 25
- Soil and Water Program 27

CROP PROTECTION AND UTILIZATION SECTION 31

- Plant Pathology Program 32
- Food Processing and Quality Evaluation Program 36
- Horticultural Entomology Program 38
- Post-Harvest Program 41
- Regional Crop Laboratory Program 45
- Weed Control Program 47

PUBLICATIONS AND PRESENTATIONS - 1989 51

APPENDIX I. METEOROLOGICAL REPORT 63

APPENDIX II. TERMS OF REFERENCE ASCHRC ADVISORY COMMITTEE 64

Alberta Special Crops and Horticultural Research Center Staff

Administration

T. KRAHN
Director

P. PETERSEN
Director's Secretary

H. ELLIS
Administrative Officer

A. MOELLER
Clerk III

J.CLARK
Librarian/Hostess

B. HUMPHREYS
Switchboard Operator

Site Operations Section

J. CHOMISTEK
Site Manager

B. COFFEY
Stockkeeper

H. CHRISTESEN
Farm Manager

R. WILLIAMS
Heavy Duty Mechanic

B. MERKL
Heavy Duty Mechanic

R. HELLMER
Farm Worker

B. WISE
Farm Worker

G. FETH
Technologist

Horticultural Production Section

C.SCHAUPMEYER
Section Head,

A. DIEMERT
Potato Technologist

M. TANIGAMI-BUNNEY
Word Processing Operator

P. RAGAN
Vegetable Crops Research, Extension

T. MARUNO
Vegetable Technologist

L. HAUSHER
Fruit Crops Research, Extension

TE-SEN PIH
Fruit Technologist

C. FETH
Vegetable Extension Agrologist

J. BUTT
Greenhouse Research, Extension

M. BRIANT
Greenhouse Crops Technologist

H. MATHERS
Nursery Crops Research, Extension

N. SEYMOUR
Nursery Crops Technologist

Special Crops and Agronomy Section

R. GAUDIEL (DR.)
Section Head

C. WILDSCHUT
Special Crops Technologist

P. MOSKALUK
Word Processing Operator

H. NAJDA
Research Agronomist, Field Crops

A. KRUGER
Field Crops Technologist

R. C. MCKENZIE
Research Agronomist, Soil and Water

N. CLARK
Soil and Water Technologist

Crop Protection and Utilization Section

R. HOWARD
Section Head

E. MOSKALUK
Pathology
Technician

K. CHAPMAN
Word Processing
Operator

A. TELLIER
Entomology
Technician

D. KAMINSKI
Diagnostician

R. ESAU
Weed Control
Specialist

B. KRUGER
Weed Control
Technologist

N. CROWE
Food Scientisit

M. DENCH
Food Processing
Technician

J. HUNG
Chemical
Technician

J. HOLLEY
Post-Harvest
Specialist and Plant
Pathologist

DIRECTOR'S REPORT

The Alberta Special Crops and Horticultural Research Center (ASCHRC) continued its role in crop diversification, emphasizing special, horticultural and field crops. Perhaps the highlight of 1989 was the emerging success of Monarda as a new crop in southern Alberta.

The Center's applied research programs continued their problem solving and industry development activities. Substantial progress was made with nursery crop cold hardiness evaluation, salinity tolerance of trees and shrubs, growth of the strawberry industry, biological control of greenhouse vegetable pests and the surveillance for Dutch Elm Disease.

Program funding was largely from line budget funding, however several projects were funded by Farming for the Future and the Alberta Research Council.

Staff changes during 1989 included the retirements of Ludolf (Rudy) Velting (Farm Worker) and Toru (Tug) Maruno (Vegetable Technologist), the resignations of David Houseman (Farm Worker), Nancy Crowe (Food Scientist), Hannah Mathers (Nursery Crops Specialist) and Annette Diemert (Potato Technologist). One vacant farm worker position was reclassified and filled by Arthur Kruger (Field Crops Technologist) and Randy Hellmer (Farm Worker) also joined the staff. The Food Scientist, Nursery Crops Specialist, Vegetable Technologist and Potato Technologist positions were vacant at year's end.

Staff continued to be actively involved in provincial, national and international organizations by participating in expert and advisory committees, and by attending conferences.

The Alberta Greenhouse Industry Assistance Program, a technology improvement program, was introduced by Alberta Agriculture and is being administered by Center staff.

The Center's Advisory Committee met twice during the year and continued to provide direction on program priorities and new program needs. A Long Range Development Plan to address these needs was drafted.

This annual report provides program by program summaries of research projects. More detailed information is available by contacting the program leader in each area.

Thomas R. Krahn, M.Sc., P.Ag.

ADMINISTRATIVE SERVICES SECTION

The section provides administrative support including purchasing, accounting, budgetary control, personnel services, library and hostess activities, computer and automated information processing, general office management and serves as the formal contact with Project Management staff of Alberta Public Works Supply and Services (APWSS).

Thomas R. Krahn, B.Sc. (Ag), M.Sc., P.Ag. ..... Director
Huber Ellis ..... Administrative Officer
Priscilla Petersen ..... Secretary & Personnel
Anna Moeller ..... Accountant
Betty Ann Humphreys ..... Receptionist & Timekeeper
Joyce Clark ..... Librarian & Hostess

During 1989 the Center hosted a number of tours and field days. The Annual Field Day on August 18 attracted over 1,500 visitors. Other commodity oriented field days were held for fruit crops and potatoes. These field days continue to be part of the Center's overall extension and public relations program.

The Center also hosted tours of the Southern Alberta Regional Planning Commission and the Faculty of Agriculture Staff, University of Alberta.

Staff continued to work closely with the APWSS and construction of the laboratory addition to the Hargrave Building was completed. The purchase of land at Bow Island for the establishment of a permanent research sub-station was completed and planning for its development commenced.

Operational budgets continued to be restricted; however, additional computer and word processing equipment was installed.

SITE OPERATIONS SECTION

This section is responsible for the grounds program, farm operations, machinery/vehicle maintenance and shop operation, activities of the Center's stockkeeper and the Center's Occupational Health and Safety Program. Site development, shelterbelt planning, planting and maintenance, irrigation system maintenance, mechanical preventative maintenance, land preparation and weather services are major areas of responsibility.

Joe Chomistek, B.Sc. (Ag), P.Ag.	Site Manager
Henry Christesen	Farm Manager
William Coffey	Stockkeeper
Roland Williams	Senior Mechanic
Barry Merkl	Mechanic
William Wise	Farm Worker
Randy Hellmer	Farm Worker
Greg Feth	Grounds Technologist

The Site Manager took responsibility for planning and developmental activities at the Bow Island Substation.

Shelterbelt redevelopment continued on the Lendrum farm.

The stockkeeper was relocated to the Hargrave Building and a Central stores concept for inventory control was instituted.

HORTICULTURAL CROP PRODUCTION SECTION

Programs in the Horticultural Crop Production Section provide research and extension services for Alberta's horticultural industries. The objectives of the section are: to improve the quality of horticultural crops produced in Alberta; to increase profits for producers by increasing yields and optimizing management inputs; and to promote the development of horticultural crop production. Industries supported include: fresh, processed, and seed potato; fresh and processed vegetable; greenhouse flower and vegetable; nursery and landscaping; and small and native fruit. Most of the programs include both cultivar evaluation and production research. Extension activities include workshops, short courses, field days, study groups, and individual consultation.

Section Administration and Potato Program

Clive A. Schaupmeyer, B.Sc. (Ag), M.Sc., P.Ag. ..... Section Head and Potato Specialist
Mayumi Tanigami-Bunney ..... Secretary
Annette Diemert, B.Sc. (Ag) ..... Technologist

Vegetable Crops

Paul Ragan, B.Sc. (Ag), M.Sc., Ph.D. ..... Research Horticulturist
Toru Maruno, Dipl. En. ..... Technologist
Cathy Feth, B.Sc., Dipl. Hort. ..... Potato & Vegetable Agrologist

Fruit Crops

Lloyd Hausher, B.Sc. (Ag) ..... Research Horticulturist
Te-Sen Pih, B.Sc., M.Sc. ..... Technologist

Ornamentals, Nursery Crops

Hannah Mathers, B.Sc., M.Sc., P.Ag. ..... Research Horticulturist
Nigel Seymour, Dipl. Hort. ..... Technologist

Greenhouse Crops

Judy Butt, B.Sc. (Ag), M.Sc., P.Ag. ..... Research Horticulturist
Murray Briant, Dipl. Hort. ..... Technologist

POTATO PROGRAM

Program Leader: C. Schaupmeyer
Agrologist: C. Feth
Technologist: A. Diemert

The objectives of the Potato Program are to assist in the selection and development of improved potato cultivars and to establish methods for improving quality and maximizing economic yields in Alberta's potato industry. This is accomplished through research, extension, and service.

RESEARCH PROJECTS

POTATO CULTIVAR IMPROVEMENT

Prairie Potato Regional Trials

The ASCHRC co-operates in the Prairie Regional Potato Trials to select improved potato cultivars for Alberta's potato industry. Approximately 300 cultivars were grown for evaluation in five trials: the Prairie Adaptation Trial, two Advanced Adaptation Trials, the Prairie Early Replicated Trial, and the Prairie Replicated Trial. Data were collected on a maximum of 39 observations and measurements for each entry in the trials. The North Central Trial was planted but not harvested because of a nearby disease problem.

The data were compiled and transmitted to D. Lynch, the Agriculture Canada potato breeder at Lethbridge. Results of the regional trials are not published, however, information on clones in the trials may be obtained by contacting the ASCHRC, or D. Lynch, Agriculture Canada Research Station, Lethbridge.

Alberta Potato Industry Cultivar Evaluation

The Potato Industry Cultivar Trials were established to commercially evaluate new potato cultivars that have "graduated" from the Prairie Potato Regional Trials. The industry trials enable growers and processors to have first-hand experience with new cultivars in the field and processing plant.

Information from the industry cultivar trials resulted in the naming of two cultivars early in 1989. These selections from the Prairie Potato Breeding Program were A69868-2, named Amisk, and W848, named Niska.

Potato growers and staff from Hostess Foods Products Ltd., Old Dutch Foods Ltd., York Farms Division of Canada Packers Inc., and ASCHRC co-operated in the Potato Industry Cultivar Trials. Two early chipping, four maincrop chipping and two French fry/table stock cultivars were evaluated in 1989. During July and August samples were

hand-harvested and data were collected on specific gravity, chip colour, French fry and baking scores and reducing sugars.

One French fry line, A74117-9, and Amisk performed well compared with Russet Burbank. An early chip line ND383-9, and a main crop chip line, W74-7, also produced higher quality chips than their comparable standards. All cultivars produced comparable or higher yields than the standards.

Progress made in the past two years with industry evaluation of promising lines was severely disrupted in 1989. The Center received seed contaminated with the bacterial ring rot organism. Although the disease was not found outside of the four 15-m test rows of the infected line, industry seed grown at the Center was destroyed. Subsequently, there will be limited industry trials in 1990 and seed will be increased for trials in 1991.

POTATO CULTURAL IMPROVEMENT

The results of potato cultural studies conducted between 1985 and 1988 are reported in *Potato Cultural Trials 1985-1988*, ASCHRC Pamphlet 89-8. Detailed information on 1989 trials will be provided on request.

Yield and Size of Norchip, Russet Burbank, and Superior Potatoes Planted on Four Dates at Five In-row Spacings

Growers using irrigation are able to manipulate populations to increase yield and/or control tuber size because plant growth is not limited by moisture. Previous spacing studies at ASCHRC (reported in the above-noted pamphlet) have shown the general trend to increased yields and reduced tuber size with closer in-row spacings. High yields are of interest to all irrigated potato growers, and small tubers are of interest for specialty fresh or processing markets, and to seed growers.

To test the effects of close spacing, Norchip, Russet Burbank, and Superior potatoes were planted on four dates between April 25 and May 25 at five in-row spacings: 10, 15, 20, 25, and 30 cm. Two trials of the first two cultivars were planted for an early and late harvest to simulate seed production and main-crop processing production. Superior was harvested on July 25.

The early harvests of Norchip and Russet Burbank produced high yields of small tubers from the plots planted on the first two dates. Mean tuber size was reduced at the closer spacings. Superior planted at 10-cm in-row spacing on the first date produced the highest marketable yield. All cultivars planted at 10 cm also produced a high yield of small seed tubers. Preliminary economic analysis using yields from the first planting date of Norchip showed that the 10-cm in-row spacing produced the highest net returns even when seed cost $300 per tonne and the selling price was $200 per tonne.

Russet Burbank doesn't have the same yield response to close spacing as Norchip, however the size of tubers is reduced significantly at very close in-row spacing.

This first year study raises an interesting point regarding the planting dates and spacing of both Norchip and Russet Burbank grown for seed under irrigation. The data show that when these cultivars are planted early and harvested late (compared with normal seed production) they can produce high yields of small tubers that are well suited for seed. The implications of extended growing seasons for seed in relation to the incidence of disease need to be considered.

Yield and Size of Three Potato Cultivars Planted at Five In-Row Spacings

Atlantic, Shepody, and Amisk (A69868-2) were planted on May 16 at five in-row spacings: 10, 15, 20, 25, and 30 cm. The total yield of Atlantic grown at 10 cm was significantly higher than the yields from the plots planted at 20, 25, or 30 cm, indicating that either the 10 or 15 cm spacing could be used for seed production. The total yield of Shepody planted at 10 cm was greater than the yields from the 25- and 30-cm spacings but not significantly different from the yields from the 15- and 20-cm spacings. Amisk, a new release from the Prairie Potato Breeding Program, responded to close spacing like Russet Burbank. It showed little yield response to close spacing, however close spacing appeared to control size of tubers.

Effects of 'Spotless' on the Yield and Vigour of Norchip Potatoes

Spotless seed treatment has been observed to enhance the growth and yield of potatoes beyond what could be attributed to the fungicidal properties. Norchip seed pieces were treated with Spotless and compared with untreated seed pieces. There were no differences in the vigour or yields between the treated and untreated plots.

SERVICE PROJECTS AND EXTENSION

The ASCHRC potato program propagated seed of approximately 150 cultivars for the Prairie Potato Breeding Program regional trials in Alberta, Saskatchewan and Manitoba. Approximately 200 hills each of advanced seedlings and 50 hills each of early lines are grown and stored at ASCHRC.

Staff provide extension service to growers and industry personnel through direct contact, newsletters and factsheets, and presentations at conferences and workshops.

VEGETABLE PROGRAM

Program Leader: P. Ragan
Agrologist: C. Feth
Technologist: T. Maruno

The Vegetable Program serves the fresh and processing sectors of a growing vegetable industry through applied field research and industry extension activities. The

fresh vegetable industry in Alberta consists of both commercial (wholesale) and market garden producers, plus processing growers that provide vegetables for the canning and freezing industry. Research activities emphasize cultivar evaluation and earliness enhancement of crops through improvements in cultural management. An extension role through on-farm visits and participation in commodity organization/activities serves to inform and educate members of the industry.

RESEARCH PROJECTS

CULTIVAR EVALUATION

Details of results on cultivars tested are reported in *Vegetable Cultivar Trials - 1989* ASCHRC Pamphlet 90-5.

Six hundred cultivars of 18 different crops were evaluated in 1989. Treatments consisted of comparisons between direct seed and transplant, early-spring and late-spring seedings, plus successive seeding regimes of selected cultivars. Many of the processing crop entries are advanced breeding lines from Europe and the United States. Final evaluation of storage crops such as carrots, cabbage and cooking onions included a 6-month storage quality assessment.

CULTURAL TRIALS

Detailed results of cultural trials and discussion of results are reported in *Vegetable Cultural Trials - 1989* ASCHRC Pamphlet 90-4.

Plant Population

Brussels sprouts were tested in a plant population trial to evaluate the response in maturity and yield. Nine population densities ranging from 10.6 to 35.8 thousand plants per hectare indicated overall yield of Oliver was most effectively increased by closer spacing of plants in the row. Large sprouts occurred at a higher frequency as both in-row and between-row spacings increased. Yield of medium-sized sprouts increased most significantly with larger distances between rows along with closer spacing of plants in the row.

Baby Carrot Production Trial

Nine cultivars of baby carrots were sown in raised and flat beds to determine if seedbed treatment had an effect on root growth and yield. Four harvests were taken on a 14-day interval and roots were graded for size and length.

Regardless of cultivar grown, the flat bed treatments produced the highest yield of marketable roots at all harvest dates. Root length of most cultivars was longer in raised beds.

Broccoli Multi-Line Spacing Trial

Two cultivars, Cruiser and Vantage, were sown in three treatments consisting of single and double-line seed drop every 15 cm and a double-line seed drop every 23 cm.

The response of cultivars to population density indicated that cultivars respond differently in overall yield and individual floret size and weight. Cultivars require field evaluation before high density plantings can be recommended.

Cauliflower Curd Initiation Trial

An attempt was made to relate the prediction of curd initiation to mean day temperature accumulation and leaf number. Fourteen cultivars were grown and data recorded to compare with subsequent years to confirm if some cultivar specific, prediction model, can be formulated.

Zucchini Population Trial

The cultivar Super Select was grown at 111, 57, and 37 thousand plants per hectare in an attempt to measure productivity in response to population pressures.

Overall yield increased along with plant density. Individual plants at higher densities produced fewer fruit, growth of individual fruits slowed down and this allowed for greater uniformity of fruit which is a distinct marketing advantage.

Garlic Fall Planting Trial

Garlic was planted August 30, September 30 and October 28 at 1-cm and 4-cm depths to evaluate winter survival and production.

Later planting reduced clove survival indicating August was the preferred month to plant garlic. The later planting dates increased yield and produced more cloves per bulb. Shallow planting increased bulb diameter.

EXTENSION AND SERVICE ACTIVITIES

In addition to a one-to-one, on-farm extension service provided to the southern region of the province, other major activities were conducted. The loan of specialized equipment to producers is a zero-cost program designed to aid in technology transfer. Popular items include precision drills, transplanters and plasticulture equipment. The Stanhay precision drill seed belt punching and calibration service provides producers using this drill an opportunity to match seed size to desired seed drop to better control plant density in the field.

Seminars for vegetable growers were given to provide cultivar recommendations and guidelines to data interpretation as reported in the ASCHRC pamphlets 90-4 and 90-5. Revision of the cole crop and vine crop production factsheets were completed.

Staff edited the Processing Vegetable Growers Newsletter which was released on a quarterly basis to keep producers informed of developments in the industry. Numerous talks to amateur gardening groups were also given.

FRUIT CROPS PROGRAM

Program Leader: L. Hausher
Technologist: P. Pih

The Fruit Crops Program serves the expanding berry and bush fruit industry in Alberta through applied research, development, and extension activities. Strawberries, raspberries, and saskatoons are the main crops studied, although other fruit crops are being evaluated for commercial potential. Extension and development activities are carried out with producers and producer organizations like the Alberta Market Gardeners Association and Fruit Growers Society of Alberta.

RESEARCH PROJECTS

Details on cultivar evaluation and cultural trials are reported in ASCHRC Pamphlet 90-6, *1989 Fruit Crop Trials.*

STRAWBERRIES

Evaluation of Junebearing Strawberries for Yield and Winter Hardiness

Sixteen cultivars and seven selections of strawberries were established in replicated blocks at the ASCHRC, Brooks, and Alberta Tree Nursery and Horticulture Centre (ATNHC), Edmonton in 1987. Two identical blocks were established at each location, one protected during the winter with straw mulch, the other left unprotected. The trials at the Edmonton site suffered herbicide damage in 1988/89 and were discarded.

Cultivars protected with straw mulch produced higher yields than those without winter protection. The cultivars Glooscap, Kent, and Bounty produced total yields of 34.8, 32.4, and 29 t/ha respectively, from the mulched area.

Evaluation of Winter Protection of Junebearing Strawberries

Replicated trials were established to evaluate the effectiveness of clear polyethylene mulch, and polyethylene in combination with straw for winter protection. Straw mulch and no mulch were used as controls.

The total yield of Kent strawberry from the polyethylene + straw treatment (43.7 t/ha) was significantly higher than that from the polyethylene treatment and the no-mulch control.

Evaluation of Day-Neutral Strawberry Cultivars

Replicated trials of four day-neutral strawberry cultivars were established in April 1989. Plants were deblossomed for six weeks and derunnered for the entire season. Harvest season was from July 6 to October 2.

The cultivars Tribute, Tristar, and Fern produced total yields of 23, 21, and 20 t/ha, respectively. Hecker yielded highest in the early season, while Tribute yielded highest in the late season.

Evaluation of Overwintered Day-Neutral Strawberry Cultivars

Replicated trials of day-neutrals planted and fruited in 1988 were overwintered under straw mulch. Upon resumption of growth in the spring of 1989, one-half of each row was deblossomed until June 1. The cultivar Tristar produced the highest yield in both treatments. Deblossoming did not affect yield. An overwintering single-row cultivar screening trial was also harvested with Tristar producing the highest yields.

Day-Neutral Strawberry Management - Planting Date

Four cultivars of day-neutral strawberries were established on April 20 and May 17. Total and marketable yields of Hecker were similar between planting dates. Yields of Tristar, Tribute and Fern were higher when planted on April 20.

Day-Neutral Strawberry Management - Deblossoming/Derunnering

Trials were established to evaluate the effects of different deblossoming and derunnering techniques on Tristar and Hecker day-neutrals. Hecker produced higher yields if it was not derunnered. The results with Tristar were inconsistent.

Day-Neutral Strawberry Management - Overwintered - Derunnering/Deblossoming

Previous year deblossom/derunner management trials were overwintered and fruited in 1989. Deblossom/derunner management was not imposed in 1989. Rows which were not derunnered in the previous year had the highest yields.

Day-Neutral Strawberry Management - Mulch/Row Cover

A trial was established with the cultivar Hecker using three colours of polyethylene mulch, poly tunnel and a spun-bond fibre product. The spun-bonded product and the clear mulch treatment severely hampered production by reducing light penetration, and excess soil temperature, respectively. The highest yields were obtained from the poly tunnel and black mulch treatments.

RASPBERRIES

Evaluation of Summer Fruiting Raspberry Cultivars

A replicated planting of 13 cultivars established in 1987 fruited for the first time in 1989. The cultivars Boyne and Amethyst were the highest yielding with an identical yield of 4.9 t/ha.

Evaluation of Summer Fruiting Raspberry Selections

A replicated planting of ten cultivars established in 1987 fruited for the first time in 1989. The selection BR1 (Chief x Indian Summer) yielded highest at 5.9 t/ha.

Evaluation of Primocane Raspberry Selections

Three primocane raspberry selections from Morden, Manitoba, and the cultivar Fallbrook were established in 1987. Plants were harvested in 1988, mowed to ground the fall of 1988, and fruited in 1989. The cultivar Fallbrook had the highest yield at 8.0 t/ha.

BUSH FRUITS

Evaluation of Black Currant Cultivars

Five black currant cultivars were established in 1979. Yield data was recorded from 1982-1985, and for a final time in 1989. The cultivar Willoughby produced a yield of 2.7 kg/bush in 1989, and had an average of 2.1 kg/bush over the five years of harvest.

Other Bush Fruits

Replicated plantings including 11 cultivars of saskatoons were established in 1988 at ASCHRC, Brooks, ATNHC, and a site near Beaverlodge. The cultivars evaluated included: Forestburg, Moonlake, Northline, Pembina, Parkhill, Honeywood, Regent, Pearson II, Smoky, Thiessen, and Success.

A trial evaluating types of saskatoon planting stock was established in 1988 at ASCHRC and ATNHC. Saskatoon seedlings, suckers and clonal plant material of Northline and Smoky were established.

EXTENSION AND SERVICE ACTIVITIES

Monthly publication of a producer oriented newsletter, *Fruit Facts*, continued. Four berry production schools were conducted for commercial growers, and a research field day was held. Assistance was given in the bulk ordering of strawberry plants for Alberta producers.

Staff continued secretarial duties of the Alberta Horticultural Congress and Trade Show and the Alberta Market Gardeners' Association. The North West Territories government was assisted in establishing demonstration research projects. Presentations were made to research, commodity, and advisory groups during the year.

ORNAMENTALS PROGRAM

Program Leader: H. Mathers
Technologist: N. Seymour

OBJECTIVES

The Ornamentals Program emphasized research on cold hardiness tolerance. Selection and breeding for improved adaptation and stress resistance were incorporated into the program.

RESEARCH PROJECTS

NURSERY PRODUCTION

Details on trials conducted before 1989 are available by requesting ASCHRC Pamphlet 89-2, *Ornamental Research Program.*

Stacking Patterns and Dormancy Evaluation Experiment Under Microfoam

In the fall of 1988 a large-scale testing program to evaluate seven types of overwintering environments was undertaken. Preliminary results have shown that stacking and covering with microfoam afforded the most effective temperature modification and winter protection. The study continued through the winter of 1989-1990.

Screening Seedlings For Cold Resistance

In the fall of 1988 three seedling screen experiments were established. Appropriate acclimation routines for cold hardiness will be developed to identify cold hardy transgressive segregants (such as temperature, day length, seedling variety) from deciduous and conifer ornamental test populations.

Overwintering of Container Stock

A trial funded by Farming For The Future was initiated to study factors which affect cold resistance of two cultivars of container-grown nursery stock: *Potentilla fruticosa* Coronation Triumph, and *Cornus sericea* Baileyi. Containerized seedlings were subjected to two acclimation regimes and then frozen in two different regimes.

WOODY ORNAMENTALS

Woody Ornamental Plant Trials

The Pamphlet 89-3, *Woody Ornamental Plant Trials*, was revised in 1989 and is available on request. An extensive update of the prairie regional trial material was completed using a list obtained from E. B. Casement of the ATNHC. The publication includes the Nurseryman's Evaluation Trials, the University of British Columbia (UBC) trial material as well as the Prairie Regional Trial plantings as far back as 1958.

Regional Woody Plant Test Program

This on-going co-operative trial between Landscape Alberta Nursery Trades Association (LANTA) and Alberta Agriculture commenced in 1983. Evaluations of woody shrubs and trees are conducted at ASCHRC in conjunction with nurseries in southern Alberta and the ATNHC, and nurseries in northern Alberta. Further information on this trial is available from the ATNHC.

Forest Genetics Trial

This trial was maintained for the Alberta Forest Service, which is co-operating with Proctor and Gable Cellulose Ltd., Grande Prairie, to evaluate the effect of latitude changes on growth rates and time of flowering of several tree species. The trial is ongoing with grafted white spruce clones, seedling white spruce strains, seedling tamarack, Englemann spruce, black spruce, lodgepole pine, Raviola larch and Siberian larch.

SERVICE PROJECTS

Golden Prairie Arboretum

Since 1981 over 500 cultivars of woody ornamentals have been established in the Golden Prairie Arboretum. This is the largest collection of deciduous ornamentals in the Canadian Prairies and is open to the public.

Forever Green Pinetum

A collection of evergreen plant material called the Forever Green Pinetum was established at the ASCHRC in 1988. Copies of Pamphlet 89-12 *Forever Green Pinetum* listing the coniferous material present can be obtained through the ASCHRC Library.

GREENHOUSE CROPS PROGRAM

Program Leader: J. Butt
Technologist: M. Briant

The greenhouse crops program at ASCHRC serves southern Alberta's greenhouse vegetable and floriculture industry by providing an intensive extension service and conducting applied greenhouse research. Extension services include crop management information, diagnosis of crop disorders, and soil and tissue test interpretations.

RESEARCH PROJECTS

Details of the following trials are reported in ASCHRC Pamphlet 89-13, *1989 Greenhouse Research Program.*

VEGETABLE CROPS

Evaluation of Powdery Mildew Resistant Greenhouse Cucumber Cultivars

Nine powdery mildew resistant (PMR) greenhouse cucumber cultivars were evaluated for their production and resistance to powdery mildew (*Erisyphe cichoracearum*). The PMR cultivars tested were Carmen, Santo, Alcor, Fidelio, Bella, Millio, TW242, Marillo and Cordoba. The check cultivar used was Corona. Seeds were sown on February 7 and plants were inoculated with powdery mildew on April 13. A disease severity rating was used to measure powdery mildew infection. Marillo had the highest marketable yield of 15.6 kg/plant and Corona the lowest yield at 9.5 kg/plant. No cultivar was free of mildew infection and Corona was the most severely infected. Quality evaluation showed significant differences between the cultivars in average attribute scores (e.g. shape and external colour).

Greenhouse Tomato Cultivar Trial

Eleven greenhouse tomato cultivars were evaluated for yield and quality. The cultivars used were Laura, Dombito, Caruso, W830, Contendo, Capello, Largetto, Domingo, Dombello, Perfecto and Colombo. W830 and Capello yielded the highest in weight and number of fruit. High summer temperatures in the greenhouse reduced marketable yield by causing cracked fruit and green shoulders. The greatest weight of culls was found in Dombello, Domingo and Colombo. In non-greenback cultivars such as Colombo, Perfecto or Largetto, cracked fruit contributed to the weight of the culls. Laura, Domingo and Dombello produced more fruit in the extra-large category. Quality evaluation of skin and flesh colour showed significant differences.

Fall and Winter Production of Day-Neutral Strawberries (In Progress)

Day-neutral strawberries, cultivars Tristar and Hecker, were dug from ASCHRC field plots and transplanted into growing bags containing a soilless growing medium.

Beginning in October 1989, one half of the plants of each cultivar received supplementary HPS lighting during daylight hours. The number of berries per plant and berry size are being recorded.

FLORICULTURE CROPS

The Effect of Two Growth Regulators on Bedding Plants

Two rates of Sumagic (uniconazole) or Bonzi (paclobutrazol) were applied to the leaves of petunias (50 ppm and 100 ppm), carnations (30 ppm and 60 ppm), and alyssum (10 ppm and 50 ppm). The highest rate of Sumagic or Bonzi produced unmarketable plants due to reduced height. Flowering was greatly delayed (petunias) or did not occur (alyssum). The low rates of Bonzi used in this trial may prove acceptable, but lower rates of Sumagic will be used in future trials. Sumagic appears to be a more powerful growth regulator than Bonzi when similar concentrations are used.

The Influence of Sumagic Sprays and Drenches on Growth of *Poinsettias*

Poinsettias (cultivar Red Sails) were treated with Sumagic sprays or drenches: 2.5 ppm spray in one, two or three applications; 5.0 ppm spray in one or two applications; 0.25 ppm drench in one, two or three applications; 1.0 ppm drench in one or two applications. One application of Sumagic at 2.5 ppm gave slight reduction in plant height and bract diameter. Additional applications of 2.5 ppm growth regulator reduced height 20-30%. Sumagic, applied at 5 ppm in one or two applications, resulted in unmarketable plants with distorted bracts. All drench applications caused some degree of bract deformity with the most severe symptoms at two applications at 1.0 ppm.

Alstroemeria Demonstration Trial

The production of ten *alstroemeria* cultivars (Cyprus, Jacqueline, Minas, Olympia, Ontario, Ostara, Paloma, Vanitas, Victorine and Westland) planted in October, 1986, was measured weekly and compared to production records of 1988. Yield was generally lower in 1989 but the high-yielding cultivars (Vanitas, Minas, and Paloma) produced similar yields in both 1988 and 1989.

EXTENSION PROGRAM

A large component of the 1989 greenhouse program involved extension services to southern Alberta greenhouse growers. This consisted of about three days per week for greenhouse visits, one day for the research component and one day for office calls and correspondence.

Additional extension participation included duties as the associate director of the Alberta Greenhouse Growers Association, and secretary of the Protected Crops Advisory Committee. Assistance to the industry in the form of workshops, meetings, industry tours and surveys was also provided.

SPECIAL CROPS AND AGRONOMY SECTION

This section conducts applied research and provides extension and development services on special crops such as pulse crops, field corn, herb and spice crops, sunflower, and other new crops. The section is also responsible for forage, cereal and oilseed cultivar testing and forage agronomy. Water management of crops and the relationship of irrigation and soil management to crop productivity are also researched by this section. Research and extension projects are conducted co-operatively with numerous other agencies. Most of the field trials are conducted in Macleod Farm at Brooks, in a new substation at Bow Island, and in farmers' fields at Rolling Hills, Standard, Acadia Valley, Duchess, Carmangay, and Bow Island.

Section Administration and Special Crops Section

Refe Gaudiel, B.S.A., M.Sc., Ph.D. Section Head & Research Agronomist
Collin Wildschut, Dipl. Hort. ..... Technologist
Pat Moskaluk ..... Secretary

Field Crops

Henry Najda, B.Sc., M.Sc., P.Ag. ..... Research Agronomist
Art Kruger ..... Technologist

Soil and Water

R. Colin McKenzie, B.S.A., M.Sc., Ph.D., P.Ag. ... Research Agronomist
Neil Clark, Dipl. RRT ..... Technologist

SPECIAL CROPS PROGRAM

Program Leader: R. Gaudiel
Technologist: C. Wildschut
Seasonal Technologist: M. Romuld
Seasonal Technologist: E. Russell

The Special Crops Program is responsible for applied research, extension, and development work on alternate and new crops for Alberta. The program also provides service to other departmental staff and commodity organizations as resource specialists and through co-operative tests and in demonstration plots.

Detailed project results are presented in ASCHRC pamphlets 89-21, *Preliminary Results of Adaptability, Agronomic and Weed Control Studies of Herbs, Spices, and Essential Oil Crops in Alberta,* and 90-1, *Special Crops Cultivar Trials.*

RESEARCH PROJECTS

EVALUATION OF CULTIVARS AND CULTURAL PRACTICES FOR DRYBEAN PRODUCTION

Seventeen yield tests were conducted at Brooks and Bow Island, under irrigated conditions, to evaluate the performance of various cultivars, selections, and breeding lines of drybeans. The Drybean Prairie Cooperative Test, an official test of the Prairie Registration Recommending Committee on Grain, is for varietal registration; the Drybean Advanced Test is for provincial varietal recommendation; and the U. S. Cooperative Nursery and numerous other observational tests are for screening purposes. Several experimental lines of pinto, pink, small white, great northern, small red, and black bean types were observed to be earlier and yielded as good or better than the standard cultivars. In addition to previous lines tested in the small white type, several new lines of the coloured bean types were observed to be upright, tall, and narrow in growth habit (archetype). One of the most promising cultivars was a black bean from the University of Idaho that was upright, narrow, tall and early maturing. Most of the archetypes were late maturing.

A foliar fertilization test was again conducted at Bow Island to determine the effects of spraying different kinds and formulations of chemical fertilizers on the foliage of two drybean cultivars. Foliar application of most of the commercially available soluble macro- and micronutrients, either once or twice in the growing season, did not increase the yield of pinto drybean. However, there was a yield increase with the application of urea.

Several cultivars of archetype drybeans were grown at different row spacings to determine the performance of these cultivars at higher populations and their feasibility for direct harvest. Some cultivars (those that were tall and narrow in growth habit) were promising for high density planting and direct harvest operation.

EVALUATION OF CULTIVARS AND CULTURAL PRACTICES FOR PRODUCTION OF OTHER PULSE CROPS

Cultivars and breeding lines of fieldpeas, lentils, fababeans, soybeans, lathyrus, lupins, chickpeas, and pigeon peas were again evaluated at Brooks, Bow Island, Standard, and Acadia Valley.

The fieldpea observational, regional, and cooperative yield tests continued to show a number of breeding lines and cultivars that were earlier in maturity and higher yielding than the standard commercial cultivars. Again, most promising were several foreign cultivars that were semi-leafless, erect in canopy growth, early maturing, and yielded as well or better than the standard cultivars.

The new red lentil, Rose, was comparable in yield to the high-yielding standard cultivar, Eston. Among the new lines of lentils tested under both dryland and irrigated conditions, the most promising were the MCPA resistant lines that were comparable in yield and plant height to the standard cultivars.

Fababean lines obtained from Lacombe in 1988 were planted at Brooks and Lacombe in 1989 for further evaluation and selection. Certain determinate fababean cultivars received from Europe yielded as well but were slightly later maturing than the local standard indeterminate ones.

No new lines of soybeans were better in performance than the check cultivars. A few selections of lathyrus that were low in neuro-toxic factor were as early to mature and comparable in yield to the old standard cultivars. The lupins evaluated at Bow Island reached maturity but yields were low. The plants' erect growth habit makes it very attractive for straight combining. The desi type chickpeas appear to be better suited for production in southern Alberta than the kabuli types. All the pigeon pea lines were very late in maturing.

EVALUATION OF CULTIVARS AND CULTURAL PRACTICES FOR PRODUCTION OF OTHER SPECIAL CROPS

Cultivars and lines of safflower, canary seed, Fenugreek, and hybrids of sunflower were evaluated at Brooks, Bow Island, Standard, and Acadia Valley. Safflower lines originally selected for higher oil content continued to show early maturity and yield that were comparable with the standard cultivar, Saffire. The Montana cultivars were all late in maturity. No new experimental lines of canary seed were better in maturity or yield than the standard cultivars. At both dryland and irrigated tests, confectionery sunflower hybrids that produced high yields and high percentages of large seeds were Sigco 974, Sigco 954, Dahlgren 131, and Interstate 8004. The oilseed sunflower hybrids were not harvested because of bird damage.

Safflower seeding date and rate tests, at three different soil moisture levels were conducted at Brooks. The later seeded plants were somewhat higher yielding than earlier seeded plants. Varying the seeding rates from as low as 15 kg/ha to as high as 30 kg/ha did not affect the yield of Saffire safflower grown under dryland, partial irrigation, and full irrigation conditions.

ADAPTABILITY, CULTIVAR EVALUATION, AND AGRONOMIC STUDIES OF HERB AND SPICE CROPS

The objective of this project, funded by the Farming for the Future program, was to determine crop adaptability, basic agronomic practices, and potential yield levels of over 100 annual and perennial crops and cultivars. Seeding and harvesting dates, row spacing and seeding depth trials were conducted. Large plots of several promising crops plus large commercial fields of a few selected spice and essential oil crops were established to gather economic yield and quality information.

The adaptability trials provided valuable preliminary information on the suitability of different crops to Alberta and also identified crop species that may have good market potential. The screening trials showed some cultivars of basil, coriander, fennel, and dill that may be suited to local conditions.

The agronomic trials provided basic cultural practices that are necessary for the production of aromatic and spice crops. Economic levels and potential constraints to commercial production were identified as well as factors necessary for the efficient processing of the crop. A number of aromatic and spice crops showed good potential for production and marketing. These crops have acceptable yields and quality to potential buyers.

CORN AND SORGHUM CULTIVAR AND CULTURAL STUDIES

Hybrid tests of grain and silage corn were conducted at Brooks and Bow Island as part of the Alberta Hybrid Testing Program sponsored by the Alberta Corn Committee. Combined results of all the tests are used to recommend hybrids for registration and to make recommendations to Alberta growers. Approximately 30 silage and 30 grain hybrids were evaluated at both irrigated sites.

Several hybrids did not reach maturity because of the cool weather during the last half of August and first half of September and the early killing frost on September 10. Several grain hybrids were earlier in maturity and as good in yield as the standard hybrids. These early hybrids offer the potential of extending the area where corn can be grown and will further reduce the risk of frost damage in areas where corn is currently being grown.

FIELD CROPS PROGRAM

Program Leader: H. G. Najda
Technologist: A. Kruger
Seasonal Technologist: M. Madge

The Field Crops Program conducts research on traditional cereal, oilseed, and forage crops to provide up-to-date information and to investigate nontraditional uses of these crops as options for the producer.

Four major projects involving over 50 trials were conducted at various locations in southern Alberta. The main testing site is at the ASCHRC; other sites are located at Standard, Acadia Valley, and Bow Island.

Several trials are conducted in co-operation with other research institutions and agencies. These include Agriculture Canada Research Stations at Lacombe (annual for-

ages), Saskatoon (forage and forage seed production), Swift Current (triticale), and the Field Crops Branch, Alberta Agriculture (cereals and oilseed). New crop varieties are also obtained for testing from universities and research agencies in Canada and abroad.

The program provides service to other departmental staff and producer and commodity organizations as resource specialist. Further details of all research trials are presented in *Field Crops Cultural and Cultivar Trials, 1989*, ASCHRC Pamphlet 90-9.

RESEARCH PROJECTS

CEREAL AND OILSEED CULTIVAR EVALUATION

Cereal and Oilseed Regional Tests

Trials co-ordinated by the Field Crops Branch, Alberta Agriculture at Lacombe were used to evaluate all recommended varieties, new varieties, and breeding lines of hard red spring wheat, durum wheat, utility wheat, barley, oats, triticale, flax, and canola. The ASCHRC is responsible for three irrigated sites (Brooks, Bow Island and Standard) and one dryland site at Acadia Valley in southern Alberta. Information from these trials, which include more than 30 sites province-wide, is used by the Cereal and Oilseed Advisory Committee to update recommendations. The committee annually produces a factsheet entitled *Varieties of Cereal and Oilseed Crops for Alberta* (available from Print Media Branch).

Irrigated regional trials were well established and harvesting was completed by mid-September. The dryland site at Acadia Valley suffered severe drought in the early summer and trials were harvested about 3 weeks earlier than the previous year. The stands at Acadia Valley were even but quite short.

Other Cereal Projects

The ASCHRC co-operates with the Field Crops Branch of Alberta Agriculture, Lacombe, with their breeding program of 2-row and 6-row barley, triticale, winter triticale, and winter wheat. The progeny and advanced line tests provide agronomic data that are used in the selection process for determining new varieties suitable for irrigated areas. Triticale grain and silage trials are conducted in co-operation with the Expert Committee on Grain Breeding.

ANNUAL FORAGE CROP STUDIES

Silage Trials

Several cultivar trials on annual forages for use as silage were conducted in 1989. The crop species evaluated included barley, oats, utility wheat, triticale, fieldpea, fababean, and forage sorghum. This was the third year of testing and the results will provide a database on variety performance for making recommendations.

In the 2-row barley trial, Klages had the highest yield and Scout, a hull-less barley, had the lowest yield over 3 years. Johnston, a 6-row barley, had the highest yield at 9000 kg/ha. Wapiti had the highest yield of triticales and Fielder was the highest silage producer in utility wheats. Foothill remains the highest producing oat variety. In the legume silage trials, Titan fieldpea had the highest yield and Bellevue fieldpea the highest protein content at 16.6% over 3 years. The highest yielding sorghum and sorghum-sudangrass varieties were Pioneer 931 and Funk 83F, respectively, under irrigation at Brooks.

Cultural Studies

The practice of double cropping spring and winter cereals for silage, hay, or pasture was investigated. Double cropping for pasture use provides high yields throughout the season and compares favourably with winter cereals seeded alone. Seeding ratios of winter and spring cereals is being investigated to determine the best combination for both efficient land use and forage quality. Barley and fall rye each seeded at 100 kg/ha produced 6% more total forage than a barley and fall rye combination seeded at 50 kg/ha. Oats and fall rye seeded at 100 kg/ha yielded 11% higher than when seeded at 50 kg/ha. Reducing the seeding rate by one-half may be an important consideration for producers.

Several new trials with annual forages were initiated in 1989. Annual legumes such as alfalfa (non dormant) and hairy vetch have the potential of improving the quality and quantity of silage or pasture when seeded with cereals. To investigate this, annual alfalfa and hairy vetch were seeded in mixtures with oats and barley for silage and with winter wheat and triticale for pasture production. Barley combined with the legumes produced higher total yield than barley seeded alone. Total yields for the winter cereal pasture combinations were not significantly different.

PERENNIAL FORAGE CROP STUDIES

Alfalfa Cultivar Evaluation

There is a lack of agronomic and yield information on the new varieties of forages, especially alfalfa, that have been registered over the past 5 years. A new alfalfa variety trial was established in 1988. In 1989 first year data were taken on three harvests. The variety Elevation had the highest yield, producing 5% more forage than the check variety Beaver.

Perennial Forage Seed Production

In 1989, three trials were initiated to investigate the economic production of grass seed under irrigation and to determine fertilizer requirements for Kentucky bluegrass, tall fescue, and perennial ryegrass. These grasses were chosen because they have a market potential for specific uses such as turf, and pasture. This is a co-operative project with R. C. McKenzie, Soil & Water Specialist, ASCHRC, and K. Miller, a producer at Milk River.

EXTENSION AND SERVICE ACTIVITIES

Presentations were made at growers' meetings and provincial advisory committees. Several extension bulletins were updated and a new one was published.

Staff served as secretary-treasurer for the Southeast Branch of the Alberta Institute of Agrologists and member of the Agriculture Technology Advisory Committee of the Lethbridge Community College. Membership in various professional organizations was maintained.

SOIL AND WATER AGRONOMY PROGRAM

Program Leader: R. C. McKenzie
Technologist: N. F. Clark

The Soil and Water Agronomy program conducts research and provides extension and expert advisory services in soil and water management for special and horticultural crops and for water use of irrigated crops. The areas of research responsibilities include all aspects of soil and water management of special and horticulture crops: fertilizer use, water use efficiency, salinity tolerance, and tillage.

Alberta Agriculture's Soil and Animal Nutrition Laboratory, Edmonton, and the Alberta Agriculture's Land Classification Laboratory, Lethbridge, provided laboratory analysis of soil and plant samples.

RESEARCH PROJECTS

Irrigation Management of Lentils

Yield data was collected for 3 years on two lentil cultivars, Eston (early maturing small seeded) and Laird (late maturing large seeded) grown under four irrigation treatments. Lentils use less water than most other crops. Maximum yields were obtained at a water use of from 270-320 mm for Laird and 260-470 mm for Eston. The highest water uses were obtained in 1988 at a site surrounded by non-irrigated fallow.

In 1987, protein content of both varieties was significantly increased by increasing the amount of irrigation, but in 1988 and 1989, protein contents remained similar under the different irrigation treatments. An important conclusion is that the protein content of lentils was not reduced by increasing the frequency of irrigation and in some cases was increased. In previous experiments, the protein content of other pulses such as fababeans and peas responded similarly to increasing levels of irrigation. This is different from cereals, forages, and vegetables where the protein contents decline with increasing amounts of irrigation.

Irrigation Management of Safflower

Two cultivars of safflower (Saffire and S208) were planted near Rolling Hills in 1989. Herbicide injury and poor emergence reduced the stand and in June the plot was abandoned and fallowed. Data from two previous years on the response of safflower to irrigation are available.

Rapid Mapping of Salinity Using an EM38 Meter

Advice on the use of an EM38 meter was provided to various government agencies and consultants. A map of the ASCHRC site at Bow Island was prepared using about 3000 salinity measurements collected by Lakeside Industries. In September, 1989, the Alberta Agriculture Land Evaluation Section commenced using an EM38 meter and data logger to map salinity at drainage and canal rehabilitation sites. In one day, a technologist with a meter and data logger is able to stake and map a 32-ha site and collect 50 measurements of salinity/ha for each of the 0-0.6 m and the 0-1.2 m depths.

Salinity and Cold Tolerance of Ornamental Trees and Shrubs

This project was commenced in 1989 as a joint project with H. Mathers, the ASCHRC Ornamentals Specialist, with financial support from Farming for the Future. Twenty seven species of ornamental trees and shrubs were planted in 1989 and one more will be added in 1990. Each species was replicated from six to ten times in each of five salinity zones. Salinity levels were determined three times during the season and a growth index was obtained on each tree based on the difference between measurements taken at the beginning and end of the growing season.

For most species, a significant correlation was obtained between the salinity level in the soil and the growth of trees. Some species were slow in getting established and required replanting. Two or more additional years data on growth should clarify the relationship between salinity and growth for all species.

Nitrogen and Soil Moisture Changes on Fallow and Stubble

This project was initiated in 1984 to measure changes in soil nitrogen and water storage on fallow and cropped fields in northern and central Alberta. Data from paired fallow and cropped sites was collected for 17 site years. Economic and soils analyses are being conducted by P. Woloshyn, R. Susko and D. Heaney, Alberta Agriculture, Edmonton. Nitrate accumulation was appreciable and soil moisture accumulation was minimal during the fallow period at the sites where data was collected.

Salinity Monitoring at Cut Sites

The process of land levelling to prepare land for irrigation often results in cut areas with exposed saline subsoils at the surface. This project was designed to measure what changes occurred in salinity at cut areas. Sampling commenced in 1984 and since 1985

has been done biennially in the late fall in two fields to a depth of 1.5 m at 14 cut sites. One field is a medium textured soil irrigated by a wheel roll sprinkler system; the other is a fine textured soil irrigated by the border dyke method. Soil salinity has varied considerably over time but no trend is evident.

Irrigation Management of Alfalfa

Two alfalfa cultivars, Apica (Flemish) and Barrier (standard), were grown at Rolling Hills. The plot was first planted in 1988 but due to winter killing was replanted in June, 1989. The effect of three cutting and four irrigation regimes on yield, quality of forage, and survival of the stand will be measured. Plant nutrients will be monitored by Diagnosis Recommendation Integrated System (DRIS) analysis and compared with established standards. In June 1989 samples were collected from 23 alfalfa fields in the Eastern Irrigation District to determine crop yield and analyzed for plant tissue nutrients, soil particle size, soil chemistry, and available soil moisture.

Tissue nutrient levels were compared with DRIS standards, dry matter yields and soil analysis from the same fields by Alberta Agriculture Soils and Animal Nutrition Laboratory. This served as an introduction to DRIS analysis and provided a preliminary survey of the nutritional status of irrigated alfalfa hay. DRIS uses standards of tissue nutrient ratios rather than nutrient concentrations to determine nutrient deficiencies because nutrient ratios do not change appreciably at different stages of maturity of the crop. DRIS analyses have been successfully used to diagnose nutrient deficiencies in the U.S.A. and South Africa.

Irrigation Management of Species of Grass Grown for Seed

This is a joint project with H. Najda, ASCHRC. In 1989 four species of grass (tall fescue, creeping bentgrass, Kentucky bluegrass, and meadow bromegrass) were seeded. In 1990 four irrigation treatments will be applied to determine the relationship between irrigation use and seed production.

Nitrogen Fertilizer Requirement of Three Grasses Grown for Seed Production

In 1989, a joint project in co-operation with M. Nakonechny of the Alberta Forage Seed Council, Ken Miller, a forage seed producer at Milk River, and H. Najda, Field Crops Agronomist, ASCHRC, was initiated. It received financial support from the Canada New Crop Development fund. The effect of three rates and two applications of nitrogen fertilizer will be measured on the seed production of perennial rye grass, turf type tall fescue, and Kentucky bluegrass.

Influence of Climatic Factors on Crop Production at Sites in East Central Alberta

This project is conducted by staff of the Chinook Applied Research Association (CARA) at Oyen. The Soil and Water Agronomy unit at Brooks arranged for soil sampling equipment and assisted with organization of soils data. In 1989, nine paired crop

and forage sites were sampled to determine crop yields, soil texture, available soil moisture and soil fertility.

CROP PROTECTION AND UTILIZATION SECTION

This Section conducts research, extension, and service programs in plant pathology, entomology, weed control, post-harvest technology, food processing and quality evaluation, and plant diagnostics. Support is provided to production research programs at ASCHRC and to agricultural industries and individual producers, both amateur and commercial, in Alberta. Crop pest surveys, diagnosis of disease, insect, and weed problems, pesticide efficacy testing, evaluation of storage practices, and food product development are examples of some of the work carried out by Section staff. Research and extension projects are done cooperatively with other ASCHRC staff and federal/provincial research agencies. Close working contacts are maintained with industry and scientific organizations in Alberta and beyond.

Section Administration and Plant Pathology

Ronald J. Howard, B.S.A., M.Sc., Ph.D., P.Ag. ..... Section Head and Plant Pathologist
Karen Chapman ..... Section Secretary
Edward Moskaluk ..... Laboratory Technician

Food Processing & Quality Evaluation

Nancy Crowe, B.Sc. (Ag.), M.Sc., Ph.D. ..... Food Scientist
Margaret Dench ..... Laboratory Technician
Joseph Hung, B.Sc. ..... Laboratory Technician

Field and Special Crops Entomology - Crop Protection Branch, Edmonton

Jim Jones, B.Sc., M.Sc. ..... Entomologist

Horticultural Entomology

Arthur Tellier, Dipl. Hort. ..... Laboratory Technician

Post-Harvest Program

James D. Holley, B.Sc., M.Sc., Ph.D. ..... Post-Harvest Scientist

Regional Crop Laboratory

David Kaminski, B.S.A., M.P.M. ..... Diagnostician

Weed Control

Rudolph Esau, B.S.A., M.Sc., P.Ag. ..... Weed Scientist
Bernice Kruger, Dipl. Agr. ..... Technologist

PLANT PATHOLOGY PROGRAM

Leader: R. Howard
Technician: E. Moskaluk

The Plant Pathology Program conducts applied research on diseases of special crops, fruits, greenhouse crops, interior plants, and cereal, oilseed, and forage crops. Research studies involve field, laboratory, and greenhouse experiments, as well as disease surveys. Findings from this and other research are presented to producers through extension programs. Consultative backup is provided to the Regional Crop Laboratory at Brooks. Further details of all research trials appear in the *Plant Pathology Program Research Report* - 1989, ASCHRC Pamphlet 90-1.

RESEARCH PROJECTS

DISEASES OF SPECIAL CROPS

Survey for Seedling Blight of Safflower

Eleven commercial safflower fields in southern Alberta were surveyed for seedling blight from May 26 to June 20. The disease was found in every field. Incidence (% blighted plants) ranged from 15.9 to 82.4% (mean = 51.5%) and severity (disease index, 0-100 scale) ranged from 9.4 to 28.6 (mean = 18.2). Seedling blight incidence was higher than in 1988 because the cool wet conditions of May 1989 favoured the disease. The main fungi isolated were species of *Alternaria*, *Fusarium*, *Penicillium* and *Pythium*. Wireworm damage (mean = 17.4%) was also seen.

Efficacy of Seed Treatments Against Seedling Blight and Possible Phytotoxicity Effects on Safflower

Ten fungicides (Agrox Flowable, Anchor, Apron 200 LS, Apron-T, Beret 400 FD, Beret MLX 360 FS, Pool NM, Thiram, Vitaflo-280 and Vitavax Single Solution) and three fungicide/insecticide mixtures (B-3, Mergamma N-M and Premiere) were evaluated in greenhouse and field trials. Most of these products provided moderate to good control of seed decay and seedling blight of safflower. Premiere, a canola seed treatment, was slightly phytotoxic. Thiram 75% WP was tested in four safflower fields, with seedling blight ranging from 1.4 to 17.3% (mean = 9.2%); yield increase was achieved only at two sites.

Trial results were published in the *1989 Pesticide Research Report* of the Expert Committee for Pesticide Use in Agriculture, Agriculture Canada, Ottawa.

Efficacy of Fungicides Against Powdery Mildew on Monarda

A one-year-old stand of monarda (*Monarda didyma*), naturally infected with powdery mildew (*Erysiphe* sp.), was sprayed with Benlate and Easout fungicides on August

4. Mildew severity was visually rated on September 8 in both treated and untreated plots. Both fungicides significantly controlled the disease, with Benlate being slightly better than Easout. Mildew levels in the check plots were moderate (26-75% of leaf area diseased).

DISEASES OF FORAGE CROPS

Effect of Dehydration and Pelleting on the Survival of *Verticillium albo-atrum* in Alfalfa Hay

The ability of *V. albo-atrum*, the fungus that causes Verticillium wilt (VW) of alfalfa, to survive the pelleting process was studied at the Alberta Dehydrating Company Limited plant in Vauxhall. Samples were taken at all stages of the pelleting process as a shipment of VW-infected alfalfa was being handled. The fungus was recovered at each stage, but at lower levels with each successive step toward the pelleted product.

DISEASES OF GREENHOUSE CROPS

Efficacy of Aerated Steam and Chemicals for the Disinfestation of Three Types of Growing Media

Aerated steam, two fumigants and five fungicides were evaluated for their efficacy in disinfesting horticultural rockwool, soil and artificial mix (Grace Mix) infested with *Pythium* spp. Samples of each medium were exposed to aerated steam (80°C) for ½, 1½ and 2 h. Other samples were treated with the fumigants Dowfume MC-2 and Basamid, and the fungicides Agral 90, No Damp, Truban, Captan, Lesan, and Ridomil, all at the manufacturers' label rates. Thirty minutes of steam treatment was sufficient to eradicate the fungus from all three media. Dowfume MC-2 and Basamid were also effective disinfestants. Captan, Truban, Lesan and Ridomil showed moderate to good efficacy against *Pythium*, whereas No Damp and Agral 90 afforded fair and poor control, respectively, of damping-off in cucumber seedlings.

Efficacy of Potassium Silicate for the Control of Powdery Mildew of European Seedless Cucumbers

Corona cucumbers growing in pots of Peters Metro Mix were treated with potassium silicates (SiO_2 25% LI) at rates of 100 and 200 ppm at intervals of 1, 2, 3 and 4 weeks between applications. A water check was included and all plants were inoculated with the powdery mildew fungus (*Erysiphe cichoracearum*) 2-3 weeks after transplanting. Silicon treatments were started at the same time and the experiment was run for 10 weeks. Silicon did not significantly reduce mildew incidence or severity, but it did increase the weight and number of marketable fruit.

Relative Resistance of Nine Cultivars of European Seedless Cucumbers to Powdery Mildew

Nine cultivars of European seedless cucumbers resistant to powdery mildew were evaluated in a greenhouse at ASCHRC for their susceptibility to an Alberta strain of the pathogen, *Erysiphe cichoracearum*. The results are given in the Greenhouse Crops Program section of this Annual Report.

DISEASES OF INTERIORSCAPE PLANTS

Efficacy of Six Fungicides Applied as Soil Drenches for the Control of Fusarium Root Rot of Grape Ivy

Rooted cuttings of grape ivy (*Cissus rhombifolia*) were transplanted into pots containing a growing medium artificially infested with *Fusarium oxysporum*. Three rates of each of the following fungicides were applied as aqueous suspensions: Truban, Vitavax-Captan, Captan, Thiram, Benlate, and No Damp. Three applications of each fungicide were made at weekly intervals in the early stages of the experiment. After 3 months none of the fungicides was 100% effective in preventing root rot. There was no improvement in control as the rates of fungicide application were increased in the later stages of the experiment. Overall, the Benlate-treated plants showed the best survival, followed by Vitavax/Captan and Thiram.

Phytotoxicity of Three Fungicides on Grape Ivy Cuttings

Rooted cuttings of grape ivy were transplanted into pots and drenched with a aqueous mixture of each of the following fungicides: Captan, Thiram and Benlate. Three applications of each product were made at weekly intervals at three rates. After 3 months, the plants were rated for symptoms of leaf burn, chlorosis and stunting. None of the three chemicals was found to be phytotoxic.

Efficacy of 'Gro Safe' Activated Charcoal in Reducing the Phytotoxicity of 'Early Finish' to Weeping Fig Plants

Studies at ASCHRC in 1988 showed that Early Finish, an institutional floor care product, was phytotoxic to young *Ficus benjamina* plants. In a follow-up trial, activated charcoal was evaluated for its ability to reduce this phytotoxicity. The charcoal was applied as an aqueous slurry at various rates to potted fig trees that had been previously drenched with Early Finish diluted in water (1:1 v/v). The plants were observed for symptoms of leaf discoloration and defoliation over a one-month period following treatment. The charcoal treatment only slightly reduced the phytotoxic effects of Early Finish, even at rates as high as 10 g of charcoal per 15 cm diameter pot.

Efficacy of Three Formulations of Lime in Reducing the Phytotoxicity of Vinegar to Weeping Fig Plants

Vinegar (5% glacial acetic acid) was shown to be highly phytotoxic to *Ficus benjamina* plants in trials as ASCHRC in 1988. The possibility of using lime to neutralize the effects of this chemical was investigated in 1989. Dolomitic, hydrated and calcium carbonate limes were mixed in water and applied at various rates to potted fig trees that had previously been drenched with dilute vinegar (200 mL/L water). The plants were observed for symptoms of phytotoxicity over a one-month period. None of the lime products at any of the concentrations tested was effective in preventing damage by vinegar. Leaching with plain tap water to dilute and flush away the vinegar was the most effective remedial measure.

DISEASES OF FRUIT CROPS

Survey of Commercial Saskatoon Orchards for Canker and Dieback Disease

R. Pluim, Graduate Student, University of Alberta, Edmonton, surveyed 11 saskatoon orchards in central Alberta and the Peace River Region. Dieback and canker disease was found in all of these plantings with disease incidence highest in south-central Alberta. There were no significant differences in disease incidence among the north-central, south-central and Peace River production areas, but the variation among orchards within these areas was highly significant. The most frequently observed symptoms were branch-tip dieback and diffuse cankers with pycnidia. Disease incidence was associated with drought stress, mechanical damage, and freezing injury. The fungus *Cytospora leucostoma* was the main cause of dieback and canker.

EXTENSION AND SERVICE ACTIVITIES

ASCHRC plant pathology staff spoke at growers' meetings, workshops and short courses. Regular contributions were made to the ASCHRC *Crop Protection Newsletter* and a number of miscellaneous publications were prepared.

The Fungicide and Fumigant Information System (FFIRS), a microcomputer-based program for accessing information from fungicide and fumigant labels, was distributed to selected individuals across Canada for evaluation. FFIRS was developed in 1988 in co-operation with the Pesticides Directorate, Agriculture Canada, Ottawa. Steps will be taken to formally register this software with Alberta Agriculture.

Staff were involved in the activities of several professional societies and advisory committees.

FOOD PROCESSING AND QUALITY EVALUATION PROGRAM

Leader: N. Crowe
Technicians: M. Dench and J. Hung

The Food Processing and Quality Evaluation Program (FPQEP) has three major objectives: to conduct applied research on horticultural and special crops produced in Alberta, to provide extension services to processors of these crops, and to perform chemical and sensory analyses as requested by other ASCHRC research staff, processors and growers.

RESEARCH PROJECTS

FRUIT CROPS

Changes in Saskatoon Berry Quality During Extended Frozen Storage

This trial was a continuation of a study begun in 1988 to examine quality deterioration (pH, colour, flavour) during frozen storage over a 24-month period. With the exception of the cultivars Thiessen and Forestburg, the pH of the saskatoons increased 0.2 to 0.5 points to a final value above 4 over the first six months of storage, at which time they stabilized. Soluble solids did not change during twelve months of storage. Many cultivars became darker in colour during storage as indicated by a decreasing Hunter L value. In the first six months, Success underwent the most rapid colour change. At harvest, five flavours were detected by gas chromatography. After six months of storage, the most volatile component was no longer detectable.

Physicochemical Characteristics of Saskatoon Berries

In the final year of this three-year study, ten saskatoon cultivars (Forestburg, Honeywood, Moonlake, Northline, Parkhill, Pembina, Regent, Smoky, Success, and Thiessen) grown at ASCHRC were examined for various physical and chemical characteristics of their berries. As in previous years, berries from Thiessen had the largest weight and size, while Regent and Pembina were consistently smaller. The proportion of the berry weight attributable to seeds (% seed weight) varied substantially between cultivars, ranging from 7.8 (Regent) to 3.7 (Moonlake). Moisture content of berries was highest for Success (82%) and lowest for Moonlake (74%). Significant differences in pH were detected, with Pembina and Smoky consistently having the highest pH (4.3) and Honeywood the lowest.

VEGETABLE CROPS

Carrot Leather

Further refinements were made to the carrot leather formulation developed in 1988. A sensory panel rated the quality of different cultivars (Lindoro, A Plus and Mark III).

Carrot leathers were acceptable regardless of the cultivar used. Product prepared using Lindoro carrots received the highest sensory scores for colour, flavour and overall acceptability. No differences in texture were detected.

Nutritional analyses indicated that 30-40% of the beta-carotene was destroyed during dehydration; however, one serving of carrot leather still supplied half of the daily recommended nutrient intake of vitamin A equivalent. Fibre content, a favourable nutritional attribute, was determined to be 2.5% as acid-detergent fibre and 3.8% as alcohol-insoluble residue. Although the oxalic acid content was substantial, it was lower than that occurring naturally in rhubarb and spinach. Under normal consumption patterns, this should not be a concern.

Shelf-life studies at ambient temperatures showed that a slight colour change (Hunter Lab colorimeter) and a loss of beta-carotene (30%) occurred. Microbial analyses indicated that coliforms, molds, yeasts and aerobic bacteria were not detected.

POTATOES

Discoloration in Prepeeled Potatoes

With the recent concerns over the use of sulfites in the food industry, processors of prepeeled potatoes are constantly seeking an alternative to sulfites. Without some additional treatment, prepeeled potatoes undergo enzymatic oxidation, acquiring an unacceptable brown discoloration and having a short shelf life (1-2 days).

A new commercial anti-oxidation product was tested and compared with an anti-browning treatment previously developed by this program. The commercial product was most effective when samples were stored under vacuum (3°C), however, even under these ideal conditions, it was not possible to consistently attain a seven-day shelf life. The ASCHRC formula, which was developed as a treatment for prepeeled potatoes, was as or more effective than the commercial product evaluated.

Glycoalkaloid Testing of Potatoes

Glycoalkaloid levels in new potato lines must be measured. A study was initiated to refine and define sampling and analysis for glycoalkaloids. To accommodate large sample numbers, common practice has been to store diced potatoes in the frozen state before analysis. Results indicated that one week of frozen storage induced glycoalkaloid formation. This increase in glycoalkaloid content (-4°C; 7 days) was the same as exposure to light for 96 hours. These results call for a serious re-examination of sample handling and analysis for glycoalkaloids.

SPECIAL CROPS

Essential Oil Extraction

The essential oil fraction was obtained from several herbs and quantified by the water-cohabitation-distillation method. Samples were distilled at various times to determine the effect of plant maturity on the quantity and composition of the essential oil. An HP-1 Hewlett Packard gas chromatographic column (10 m x 0.53 mm) and a run time of 30 minutes were used to analyze the chemical constituents present in the essential oils. In addition, refractometric and specific gravity readings were made on some samples. This project is funded through Farming for the Future.

EXTENSION AND SERVICE ACTIVITIES

Food safety, nutritional quality, and sulfites were areas in which there were requests for information. The services offered as part of the FPQEP included analysis of samples submitted by producers and processors. Assistance was provided to three different cottage-scale jam processors and to several entrepreneurs involved with essential oils and herbs and spices.

Liaison with other agriculture and food related agencies was maintained. Staff continued to play an active role in the regional and national levels of professional societies by presenting workshop and technical seminars, and scientific papers.

HORTICULTURAL ENTOMOLOGY PROGRAM

Leader: R. Howard
Technician: A. Tellier

The Horticultural Entomology Program conducts research and provides extension and diagnostic services. Research is directed toward major pest problems on selected horticultural crops Extension assistance is given to Alberta's agricultural industry, to individual growers, and to Alberta Agriculture extension staff. Diagnostic services are provided to clients of the ASCHRC Regional Crop Laboratory and to ASCHRC researchers. Pest control recommendations are often made in conjunction with diagnoses rendered on specimen submissions by commercial and amateur producers.

RESEARCH PROJECTS

GREENHOUSE PEST MANAGEMENT

Biological Control of Western Flower Thrips (WFT) in Cucumbers

The Horticultural Entomology Program provided on-site supervision and technical assistance to a research program organized by M. Steiner, Alberta Environmental Centre, Vegreville, supported by a Farming for the Future Program grant.

Having demonstrated in 1988 that the predatory mite *Amblyseius cucumeris* was potentially an effective biocontrol of WFT, the main objective of 1989 trials was to reduce the number of introductions of *A. cucumeris* to an economical level. Because of the problems with diapause before April, growers were advised to control WFT in the fall and to use endosulfan (Thiodan) to keep infestations at low levels until April. *A. cucumeris* populations can survive direct treatment of Thiodan, whereas methomyl (Lannate L) and deltamethrin (Decis) kill them and leave harmful persistent residues. Five introductions were made between March 22 and April 24, 1989, for a total of 500 predatory mites/plant. The mites were slow to establish before late April due to either weather related conditions or mite diapause requirements and the need for an establishment period of about four weeks. The shortened introduction period did not affect the control of thrips relative to 1988. If WFT populations are low before April (<1 larva/leaf), and no major disrupting factors such as harmful pesticides are used, *A. cucumeris* will maintain thrips below economic threshold levels and respond to thrips population increases without requiring subsequent introductions. Where WFT populations are already high in April, unacceptable fruit damage and yield loss may occur before the predators can reduce thrips populations. In a survey of 22 commercial greenhouse growers conducted in December, 1989, 13 who had used *A. cucumeris* reported they were reasonably satisfied with the level of thrips control, and 19 indicated they would adopt a biological control program in 1990.

Recommendations for 1990 will state that a minimum of four introductions of 50-100 predators/plant, two during late February and early March and two during late March and early April, are required to successfully control WFT. All plants should receive predators at each introduction to ensure good distribution throughout the crop.

Biological Control of WFT in Cucumbers and Peppers Using a Native Predator

The minute pirate bug, (*Orius tristicolor* White), is a well-known predator of WFT. In 1988, studies with *O. tristicolor* as the sole predator for thrips in greenhouse cucumbers resulted in significant reduction in thrips densities and fruit damage. Of particular significance was the season-long reduction in fruit scarring. The low introduction rates of this predator make it a potential commercial proposition.

In 1989, *O. tristicolor* was introduced in commercial and research greenhouses to see whether it would complement *A. cucumeris*. One pepper crop and five cucumber

crops were monitored. *A. cucumeris* was released at all sites at rates of 18.5 to 676/plant beginning in late March and continuing until early June. The predators established well at four of the six locations. Two introductions of *O. tristicolor* adults were also made at each site. At two sites, laboratory-reared *O. tristicolor* adults were released in early April at a rate of 6/plant. At the remaining sites, field-collected adults were released at rates of 0.5 to 6/plant. Laboratory-reared *O. tristicolor* failed to establish, possibly due to heavy powdery mildew infestations on the leaves. Field-collected *O. tristicolor* established well and thrips populations were reduced below economic thresholds. In the current season crop, releases of *O. tristicolor* were made on July 4 and 21, at a rate of 0.6/plant. A substantial decline in the thrips population due to predation by *A. cucumeris* was evident during late May and June. Thrips densities continued to decline after introductions of *O. tristicolor* adults, with no apparent impact on *A. cucumeris* populations. This suggests the two predators may be compatible and complementary.

Efficacy of Three Miticides on Greenhouse Roses

Three miticides were tested for their efficacy against the two-spotted spider mite, *Tetranychus urticae* Koch, in cooperation with a commercial rose producer in Redcliff. Resident populations of two-spotted spider mites have built up resistance to some of the currently registered miticides, thereby limiting alternation between chemical groups and encouraging resistance to develop to the most effective miticide, dienochlor (Pentac). The objective of this trial was to obtain data to support the minor use registration of a new miticide, avermectin (Avid), which is currently registered on greenhouse ornamentals in the United States and is pending registration in some European countries. The trial had four treatments: Pentac Aqua Flow at 0.65 mL/L, Vendex 50% WP at 1.0 g/L, Avid 0.15 EC at 0.32 mL/L, and an untreated check. Treatments were applied weekly for 2 weeks and counts were made before the initial application, 3 days and 7 days after each treatment to determine percentage reduction of spider mite populations. Pentac was effective, but inconclusive results were obtained with the other products.

PEST SURVEYS

Dutch Elm Disease (DED)/Elm Bark Beetle Survey

Twenty-seven sites in southern Alberta were monitored for DED vectors. Traps were purchased by several cities, and a distribution system was organized by J. Holley and A. Tellier, ASCHRC. Distribution and reading of the traps was done by the ASCHRC Entomology Laboratory. Beetles were identified by D. Langor, Northern Forestry Centre, Edmonton. *Hylesinus criddlei*, a secondary pest of green ash, was the only beetle trapped in 1989 during July and August in the Warner, Foremost and Coutts areas. Recommendations were made to Raymond town officials to control infestations of *Hylesinus californicus* and *Podosesia syringae fraxini* (ash borer) in 1990. This location will be monitored in 1990.

Several loads of firewood confiscated at the U.S./Canada border crossings were destroyed. One load examined early in the year contained several elm logs infested with

dead *Scolytus multistriatus* (smaller European elm bark beetles) and had many feeding galleries.

POST-HARVEST PROGRAM

Program Leader: J. D. Holley

The objectives of the Post-Harvest Program are to maximize the longevity and quality of stored horticultural crops. Other responsibilities include diagnoses and determination of treatments for major diseases and disorders on potatoes, vegetables, turf, and herbaceous and woody ornamentals.

New controlled environment storage rooms at ASCHRC should be ready for storage trials by spring, 1990.

RESEARCH PROJECTS

DISEASES OF POTATOES

Early Blight Resistance Screening

Vines infected with early blight (*Alternaria solani*) were ploughed under in the fall of 1988 to prepare for early blight screening in 1989. Two cultivars and 31 advanced breeding lines were established on the infested site. The percentage blight was estimated during the second week of September and each cultivar or line was classed as susceptible, moderately susceptible, moderately resistant or resistant. Lines AV77431, BR7093-24, FV7704-10, ND17848-3, ND18171-3, F79054, AV7788-9, and WIS81-15 were as resistant as the check Russet Burbank.

Verticillium Wilt Resistance Screening

Cultures of *Verticillium albo-atrum* and *V. dahliae* were grown on barley seed three weeks prior to planting. Two cultivars and 12 advanced breeding lines were planted with the infested mixture. Wilt symptoms did not appear on the foliage. Discoloration of vascular tissues, however, was well developed in tubers after harvest. Proportions of 30 tuber samples with vascular discoloration were analyzed to classify levels of Verticillium wilt resistance as low, intermediate or high. Lines MIN12251, WIS76-17, ND1455-12, ND2003-2, ND1444-2, and WIS77-44 were as resistant as the check Russet Burbank. This is the first season that breeding lines have been successfully screened for resistance to this wilt disease.

Fusarium Wilt Resistance Screening

The method outlined for Verticillium wilt screening was used to test 2 cultivars and 12 advanced breeding lines for resistance to Fusarium wilt (*Fusarium oxysporum*). A virulent culture of *F. oxysporum* was used to inoculate tubers. Vascular discoloration in tubers was analyzed to classify resistance as low, intermediate or high. Lines MIN12251, ND671-4, WIS76-17, and ND671-4 were as resistant as the check Russet Burbank. This is the first season that seedlings have been tested successfully for resistance to this wilt disease.

Rhizoctonia Canker and Black Scurf

The method outlined for Verticillium wilt screening was used to test 2 cultivars and 12 advanced breeding lines for resistance to *Rhizoctonia solani*. Purple top and aerial tuber symptoms and black scurf on tubers were low. Percentages of underground stems with canker were analyzed to rank them as susceptible, moderately susceptible, moderately resistant or resistant. Lines ND1444-2, NDA848-3, MIN12251, ND1455-12, WIS76-17 were as resistant as the check, Atlantic.

Effect of Sodium Hypochlorite on Potato Seed

Many potato growers rinse or spray potatoes with a solution of sodium hypochlorite (bleach) prior to storing them, even though this is not a recommended practice. In trials at the ASCHRC, dipping seed into 6% bleach for 2 to 5 minutes significantly reduced germination of both Norchip and Russet Burbank, particularly if tubers were not rinsed with water. Dipping seed into a 1:10 dilution of bleach in water did not inhibit germination of either cultivar, even without rinsing. Poor germination and high levels of soft rot after planting may be caused by fluctuating levels of relative humidity in potato storage rather than by the use of bleach. This, however, needs to be investigated further.

Resistance to Benzimidazole Fungicides in the Silver Scurf Pathogen

Many processors have experienced increasing difficulty in peeling potatoes mechanically because of high levels of silver scurf (*Helminthosporium solani*). Chips or fries made from diseased potatoes show burned or brown edges after frying making the product unappetizing. Scurf in potatoes grown in Alberta has risen steadily over the past five years, even though production practices have not changed significantly. About 30% of *H. solani* isolates recovered from potatoes stored in southern Alberta showed high levels of resistance to the fungicides thiabendazole (Mertect) and thiophanate-methyl (Easout). Mertect is the only fungicide registered for post-harvest application on potato. Easout is used to treat seed.

DISEASES OF TURFGRASS

Fairy Ring Control

Results from 1988 indicated that the experimental fungicide ICI 0523 or Anvil might be effective in controlling fairy ring on turf. A trial was set up at McCall Lake golf course in Calgary to assess the efficacy of this fungicide in a typical commercial setting with a well-developed problem. Strips, 5 x 50 m, were sprayed with Anvil at four different rates in mid-June. One half of each tested strip was re-sprayed in mid-July. Each strip had a minimum of 30 well-developed rings. The number of rings and severity of each ring in each strip was recorded prior to treatment.

SERVICE ACTIVITIES

Samples from 24,000 acres of commercial potatoes were tested for bacterial ring rot in 1989 with one confirmed case of the disease. Unfortunately, ring rot was found on the Lendrum Farm at ASCHRC. All seed grown on the Lendrum Farm was discarded. Experimental lines that could not be obtained elsewhere were tested for ring rot and tissue cultures established from disease-free tubers.

The monoclonal antiserum test used for ring rot detection was made more reliable by reconstituting each reagent just before use. A new latex agglutination test, available from the Agriculture Canada Research Station in Fredericton, NB, was introduced this year.

To prevent the introduction of DED into Alberta, a bark beetle monitoring program was set up with co-operating district agriculturists, pest control officers and city parks personnel. Firewood confiscated at Chief Mountain by Canada Customs officers harboured bark beetles and also showed blue staining, characteristic of DED.

EXTENSION ACTIVITIES

Seminars describing DED were given to new customs personnel alerting them of the importance of the firewood confiscation program.

The lack of precision and consistency in controlling relative humidity is a problem for the potato industry in Alberta. Seminars were given to show growers how to use simple devices such as sling psychrometers to accurately monitor levels of relative humidity in their storage facilities.

The chapter on potato diseases was revised for the Western Committee on Plant Disease Control. It will be published in 1990.

Participation continued on the Dutch Elm Action Committee, the Alberta Potato Research Committee, the Western Committee on Plant Disease Control, and the Storage Committee for the Prairie Potato Council.

REGIONAL CROP LABORATORY PROGRAM

Project Leader: D. Kaminski
Seasonal Technician: S. Helmer

The Southern Alberta Regional Crop Laboratory (RCL) provides plant disease, insect and plant identification as a service to both commercial and non-commercial clients. The RCL is operated by a diagnostician and a seasonal technician. An information officer is supervised by the diagnostician.

The RCL received 1361 plant disease, insect, and plant identification specimens in 1989. That number was down slightly (7%) from the previous year. There was a slight reduction in the numbers of insect and plant identification specimens, but a corresponding increase in plant disease specimens. Major increases were in the numbers of greenhouse and amenity turf specimens. Woody ornamentals again constituted the largest share of both plant disease (32%) and insect (33%) specimens. The relative proportions of domestic vs. commercial specimens remained nearly the same as in 1988.

The summaries that follow were detailed in the *Crop Protection Newsletter* (Southern Alberta) (CPN), Vol. 14, No. 1 (January 1990). Diagnostic records back to 1985 are maintained using dBase III Plus software and an IBM PC/AT microcomputer.

Interesting and unusual problems that appeared in 1989 included our first case of Tomato Spotted Wilt Virus on *cineraria*. This disease has a very wide host range, including tomatoes and cucumbers, and has become a serious problem in commercial greenhouses in B.C. Another was fireblight, *Erwinia amylcvora*, on Boyne raspberry. Bacterial isolates from this host were morphologically distinct from those derived from apple. Samples of *Poinsettia* were received with a variety of root problems, especially feeding injury from fungus gnat larvae.

The insect most frequently submitted and enquired about was the adult of the beet webworm, *Loxostege sticticalis*. Although the moths were plentiful in the spring, there were only spotty infestations of larval feeding damage.

The resources of staff and facilities were stretched yet further in 1989, with the RCL being relocated to temporary quarters in the basement of another building at the ASCHRC. This inconvenience will be resolved in the coming season as we utilize our newly renovated and expanded facilities. Another strain on resources, albeit a fruitful one, was the effort of the diagnostician to see things in their "field" context by visiting each district agriculturist (DA) in Region 1 (southern Alberta). This initiative will be continued in 1990 with visits to the DAs in Region 2 (south-central Alberta).

Table 1. Summary of plant disease, insect, and plant identification specimens received at the southern Alberta Regional Crop Laboratory (January 1 - December 31, 1989)

Category	No. of Specimens	% of Total	% Commercial
Plant Disease			
Woody Ornamental	285	32	6
Greenhouse Crop	160	18	83
Vegetable Crop	112	12	32
Cereal	87	10	98
Fruit	67	8	11
Interior Plant	51	5	34
Herbaceous Ornamental	43	5	35
Oilseed	34	4	84
Forage	21	2	100
Special Crop	18	2	61
Miscellaneous	14	2	40
TOTAL	892	100	36
Insects			
Woody Ornamental	106	33	0
Household Pest	71	22	12
Miscellaneous	38	12	5
Fruit	25	7	16
Cereal	23	7	100
Greenhouse Crop	15	5	86
Herbaceous Ornamental	15	5	7
Vegetable Crop	10	3	30
Interior Plant	8	3	13
Oilseed	6	2	100
Forage	3	1	67
TOTAL	320	100	17
Plant Identification			
Park/Yard/Garden	72	48	4
Annual Crop	25	17	96
Miscellaneous	24	16	65
Pasture	15	10	93
Forage Crop	7	5	100
Water Course/Slough	4	3	0
Waste Area	2	1	0
TOTAL	149	100	43

The information officer dealt with a wide range of topics, and between April 24 and August 31 answered 2636 telephone inquiries. During peak periods, there were, on average, 30 calls per day. The major subject areas are summarized below. Other less frequent inquiries covered such topics as annuals and perennials, herbs, companion planting, landscaping, composting, fertilizers, plant propagation, house plants, greenhouse production, mushrooms, potatoes, roses, soils and water quality. This position benefits all programs at the ASCHRC by freeing the specialists to conduct valuable research and extension to commercial growers.

Table 2. Major subject areas of phone inquiries to the information officer (April 24 - August 31, 1989)

Subject	Number of Calls
Entomology	426
Trees	370
Shrubs	307
Plant Pathology	233
Pesticides	211
Tree Fruit	170
Vegetables	127
Bush Fruit	101
Lawns	74
Pruning	73
Weeds	59

WEED CONTROL PROGRAM

Leader: R. Esau
Technologist: B. Kruger

The major objectives of the Weed Control Program are: to improve existing weed control practices for vegetable, potato, fruit, and nursery and special crops by evaluating commercial and experimental herbicides; to assist with the diagnosis of herbicide injury and the identification of plants submitted to the ASCHRC Regional Crop Laboratory; and to provide weed control information to commercial and non-commercial growers. Further details of all research trials appear in the *1989 Weed Control Trials*, ASCHRC Pamphlet 90-14. All rates quoted in this program report are in terms of active ingredients per hectare.

RESEARCH PROJECTS

WEED CONTROL IN VEGETABLE CROPS

Onions. Studies to assess the tolerance of onions (Aries, Improved Autumn Spice and Norstar) to bromoxynil (Torch, Pardner) were concluded in 1989. Onions were consistently injured when treated at the loop stage; however, yields were not significantly affected. Bromoxynil at 0.1 kg/ha applied at the first- and second-leaf stages caused only minor injury.

Similarly, the tolerance of onions to oxadiazon (Ronstar) at the loop-, one- and two-leaf stages was investigated. Crop injury was severe when sprayed at the first two growth stages; yields and plant stands were unaffected. In a second trial, oxadiazon sprayed at 1.14 kg/ha did not adequately control wild mustard and wild tomato and yields were reduced in relation to the weed-free check.

Cucumbers. Clomazone (Merit) at 0.35, 0.5 and 0.9 kg/ha was applied preplant incorporated (PPI) on Slice-Nice cucumbers. Clomazone caused temporary crop injury which was manifested by whitened leaves. It did not control redroot pigweed; consequently, clomazone-treated plots produced no yields.

Cabbage. Napropamide (Devrinol) at 1.1 kg/ha PPI and pyridate (Lentagran) at 0.75 to 0.9 kg/ha post-emergence were safe for use in cabbage. Nevertheless, yields were reduced due to wild mustard infestations. These herbicides controlled lamb's-quarters and redroot pigweed. Pyridate controlled wild tomato but napropamide did not.

Processing Peas. RE 40885 (Benchmark) was phytotoxic when applied at rates of 0.8 kg/ha and higher. A combination of trifluralin at 1.1 kg/ha plus RE 40885 at 0.4 kg/ha provided acceptable crop safety and weed control. A test was also conducted with fenoxaprop-p-ethyl to obtain crop samples for residue analyses; the objective was to reduce the current pre-harvest interval of 90 days. In a third trial with processing peas, trifluralin plus metribuzin PPI, fall or spring applied, caused considerable crop injury.

HERBICIDE CARRY-OVER

Imazethapyr (Pursuit) was applied at 0.025 to 0.100 kg/ha to plots for recropping studies. Crops to be planted in 1990 are canola, soft wheat and potatoes.

WEED CONTROL IN NURSERY CROPS

In one test the graminicides sethoxydim (Poast) and fluazifop-p-butyl (Fusilade DF) were applied to six woody ornamental species (Potentilla, saskatoon, spirea, lilac, juniper and globe cedar). None was adversely affected by the graminicides. In another test, dichlobenil (Casoron 4G) was tested at three rates on Nanking cherry, dogwood and lilac. Lilac plants (15 cm tall) were severely injured by dichlobenil at 4.5 and 6.0 kg/ha, but not at the lowest rate, 3 kg/ha. Dogwood and Nanking cherry (2-3 times the size of lilac plants) were unaffected by dichlobenil at the three rates tested. In a third trial,

granular formulations of trifluralin, napropamide and oxadiazon were found to be effective and safe.

WEED CONTROL IN SASKATOONS

Dichlobenil (Casoron 4G) was tested at Sexsmith, Goodfare and Brooks, AB to generate data required for registration of this product on established saskatoons. Fall-applied dichlobenil at 4.5 to 9 kg/ha did not cause any noticeable crop injury at any of the three test sites. These trials were partly funded by the Minor Use of Pesticides Program (Agriculture Canada). In addition, spring-applied dichlobenil was tested at Brooks and found to provide similar results.

WEED CONTROL IN POTATOES

An experimental herbicide, SB-53482, applied as a pre-emergent, was found to be severely phytotoxic to potatoes at the three rates tested (50, 75 and 100 g/ha).

Two formulations of bentazon (BAS 351-40, Basagran) at 0.84 and 1.08 kg/ha were evaluated on four potato varieties. Atlantic and Russet Burbank were temporarily injured by both formulations, whereas Norchip and Norland were unaffected.

In a third trial, five treatments of clethodim (Select), three of propaquizafop (Agil), sethoxydim (Poast), and two of fenoxaprop-p-ethyl were tested for control of green foxtail, wild oats and volunteer barley in Russet Burbank potatoes. The treatments did not affect the crop. Propaquizafop at 35 g/ha controlled green foxtail and volunteer barley, but wild oats only marginally. Sethoxydim at 0.25 kg/ha and clethodim at 60 to 90 g/ha with ammonium sulphate and clethodim at 75 to 105 g/ha without ammonium sulphate, and fenoxaprop-p-ethyl at 0.1 and 0.2 kg/ha controlled these grasses.

WEED CONTROL IN PULSE CROPS

A trial to control wild tomato and hairy nightshade in dry beans was continued in co-operation with Agriculture Canada, Lethbridge. Selected herbicidal treatments were applied to 10 m^2 plots replicated four times in a randomized complete block design. At Brooks, wild tomato did not emerge in sufficient numbers to assess its control by herbicides. Other weeds, primarily redroot pigweed, lamb's-quarters and wild mustard, were effectively controlled by: ethalfluralin (Edge) + Clomazone (Merit) at 0.84 + 0.35 kg/ha; ethalfluralin plus various rates of imazethapyr (Pursuit) applied pre-plant incorporated or the latter herbicide applied postemergence with a surfactant; and imazethapyr alone at 50 to 75 g/ha applied postemergence with a surfactant. These treatments and ethalfluralin at 1.1 kg/ha alone provided yields which were equivalent to the hand-weeded check. None of the 21 treatments injured dry beans.

HERBS AND SPICES

Tests to determine tolerance of monarda and spearmint to sethoxydim (Poast) at 0.25-0.5 kg/ha with ammonium sulphate plus Merge surfactant 1% v/v and ethalfluralin (Edge) at 0.8, 1.1 and 1.6 kg/ha were located at Brooks and Bow Island. No noticeable injury was observed to either crop at either site. These tests were partially funded by the Minor Use of Pesticides Program.

Work continued with linuron (Afolan, Lorox) applied post-emergence on dill, coriander and caraway. Coriander was tolerant to linuron at 1.2 kg/ha, but dill was only tolerant to 0.8 kg/ha. In another trial, twelve herbicidal treatments were evaluated for crop tolerance and efficacy on eight species (monarda, hyssop, basil, summer savory, fenugreek, poppy, oregano, and sage). These crops are mostly of the *Labiatae* or mint family. Herbicides tested included linuron, ethalfluralin, napropamide (Devrinol), bentazon (Basagran), and bromoxynil (Pardner).

HERBIGATION

A herbigation trial was conducted to test the efficacy of several herbicides for late-season nightshade control in dry beans. The chemicals were applied after the initial emerging weeds had been controlled by cultivation. Metolachlor (Dual) and EPTC (Eptam) were applied with a backpack sprayer, followed immediately by irrigation to simulate herbigation. These herbicides did not cause any crop injury. Few weeds emerged after cultivation in the herbicide and control treatments.

EXTENSION AND SERVICE ACTIVITIES

Staff provided recommendations and follow-up for weed control in various crops for ASCHRC staff and by telephone calls and farm visits to commercial and amateur growers. Staff contributed to the ASCHRC *Crop Protection Newsletter*. Pesticide inventory was maintained and pesticide supplies were ordered to meet program demands for the Center.

Presentations were made at several growers' meetings, field days and provincial advisory subcommittees. An overview of the biology of quackgrass was presented at a farm meeting during National Quackgrass Week April 3-9. A weed field day was held on July 25 for weed research and extension specialists.

For the Expert Committee on Weeds (Western Canada Section), suggested treatments were updated and a report was prepared for the Research Appraisal and Planning Committee covering eight vegetable crops. Staff also served as a council representative for the Alberta Institute of Agrologists, completed duties as secretary for the Expert Committee on Weeds (WCS) early in 1989, and served on the Center's electronic data processing committee.

The Weed Control Program co-operated with two chemical companies in studying the persistence of triasulfuron and sulfosate at ASCHRC.

PUBLICATIONS AND PRESENTATIONS - 1989

ABSTRACTS

In report to the Committee on Horticultural Research, Canadian Horticultural Council. March, 1989.

- Quality Changes During Frozen Storage of Saskatoons. N. L. Crowe, J. Hung, and M. Dench
- Preplant Incorporated Treatments in Peas. R. Esau and B. Kruger
- Weed Control in Established Saskatoons with Dichlorobenil. R. Esau
- Overwintered Day-Neutral Strawberry Cultivars. L. Hausher
- Day-Neutral Strawberry Management. L. Hausher
- Effect of Polyethylene Winter Mulch on Fruit Protection of Junebearing Strawberry. L. Hausher
- Efficacy of aerated steam and chemicals for the disinfestation of growing media used in the production of greenhouse cucumbers. R. J. Howard, E. R. Moskaluk, M. A. Briant and J. A. Butt.

In Research Report, Expert Committee on Weeds (Western Canada Section). December, 1989. Abstracts by R. Esau and B. Kruger, except as noted.

- PPI Treatments for Weed Control in Green Peas
- Weed Control in Cabbage
- Weed Control in Cucumbers
- Weed Control n Coriander and Dill
- Tolerance of Monarda to Ethalfluralin. R. Esau, B. Kruger, and B. Roth
- Tolerance of Monarda to Sethoxydim. R. Esau, B. Kruger, and B. Roth
- Tolerance of Spearmint to Sethoxydim. R. Esau, B. Kruger, and B. Roth
- Tolerance of Spearmint to Ethalfluralin. R. Esau, B. Kruger, and B. Roth
- Control of Annual Grasses in Potatoes
- Tolerance of Potato Cultivars to Bentazon
- Tolerance of Onions to Bromoxynil
- Oxadiazon for Weed Control in Onions
- Tolerance of Onions to Oxadiazon
- Weed Control in Established Saskatoons. R. Esau and S. Kitt
- Tolerance of Established Saskatoons to Dichlobenil. R. Esau, B. Kruger, and S. Kitt
- Evaluation of Graminicides for Use in Ornamentals
- Herbicidal Weed Control in Nursery Containers
- Dichlobenil for Weed Control in Nursery Containers
- Fall-Applied Metribuzin for Peas
- Control of Annual Grasses in Green Peas
- Tolerance of Peas to Bentazon Formulations
- Control of Wild Tomato in Dry Beans

In Pesticide Research Report, 1989. Expert Committee for Pesticide Use in Agriculture, Agriculture Canada, Ottawa. January, 1990.

- Phytotoxicity of Nine Seed Treatment Fungicides on Safflower and Efficacy Against Seed Decay and Seedling Blight. R. J. Howard and E. R. Moskaluk.

- Efficacy of Eight Seed Treatment Products Against Seed Decay and Seedling Blight of Safflower. R. J. Howard and E. R. Moskaluk.

- Efficacy and Phytotoxicity of Eleven Seed Treatments Against Seed Decay and Damping-off of Safflower. R. J. Howard and E. R. Moskaluk.

- Efficacy of Eleven Seed Treatments Against Seed Decay and Seedling Blight of Safflower. R. J. Howard and E. R. Moskaluk.

- Efficacy of Thiram Seed Treatment Against Seed Decay and Seedling Blight of Safflower. R. J. Howard, E. R. Moskaluk, B. T. Roth, and E. L. Mathews.

RESEARCH REPORTS

Butt, J. 1989. Greenhouse Research Program - 1989. ASCHRC Pamphlet 89-13. 11 pp.

Crowe, N. L., J. Hung, and M. Dench. 1989. Report of the Food Processing and Quality Evaluation Program. ASCHRC Pamphlet 90-7.

Esau, R., and B. Kruger. 1989. Weed Control Trials. ASCHRC Pamphlet 90-14. 41 pp.

Gaudiel, R. G. 1989. Preliminary results of adaptability, agronomic and weed control studies of herbs, spice and essential oil crops in Alberta. ASCHRC Pamphlet 89-21.

Gaudiel, R. G. 1990. Special Crops Cultivar Trials. 1989. ASCHRC Pamphlet 90-1.

Hausher, L. G. 1990. Fruit Crop Trials, 1989. ASCHRC Pamphlet 90-6. 45 pp.

Howard, R. J. and E. R. Moskaluk. 1990. Plant Pathology Program Research Report. ASCHRC Pamphlet 90-10.

Mathers, H. M. 1989. Ornamental Research Program. ASCHRC Pamphlet 89-2. 31 pp.

Mathers, H. M. 1989. Woody Ornamental Plant Trials. ASCHRC Pamphlet 89-3. 29 pp.

Mathers, H. M. 1990. Annual Flower Trials - 1989. ASCHRC Pamphlet 90-2. 12 pp.

Najda, H. G. and A. Kruger. 1989. Field Crops Cultural and Cultivar Trials. 1990. ASCHRC Pamphlet 90-9. 35 pp.

Ragan, P. 1990. Vegetable Cultural Trials - 1989. ASCHRC Pamphlet 90-4. 21 pp.

Ragan, P. 1990. Vegetable Cultivar Trials - 1989. ASCHRC Pamphlet 90-5. 41 pp.

Schaupmeyer, C., B. Hanel and A. Bergen. 1989. Potato Cultural Trials, 1985-1988. ASCHRC Pamphlet 89-8. 54 pp.

Tellier, A. J. and R. J. Howard. 1989. Horticultural Entomology Program Research Report. ASCHRC Pamphlet 90-18.

SCIENTIFIC PAPERS

Evans, I. R., Kharbanda, P. D., Harrison, L. and Kaminski, D. 1989. Blackleg of Canola Survey in Alberta. Can. Plant Dis. Surv. (in press).

Howard, R. J., M. A. Briant, J. A. Butt, and E. R. Moskaluk. 1989. Survey for Stem Rot and Canker Diseases of Greenhouse-Grown Cucumbers. Can. Plant Dis. Surv. 69(1):73.

Howard, R. J., D. A. Kaminski, J. A. Butt, and R. A. Pluim. 1989. Survey for Corky Root (*Pyrenochaeta lycopersici*) in Greenhouse-Grown Tomatoes. Can. Plant Dis. Surv. 69(1):77.

Howard, R. J. and E. R. Moskaluk. 1989. Survey for Verticillium Wilt of Alfalfa. Can. Plant Dis. Surv. 69(1):48.

Howard, R. J., E. R. Moskaluk, and F. T. Allen. 1988. Survey for Seedling Blight of Safflower. Can. Plant Dis. Surv. 69(1):69.

Hwang, S. F., R. J. Howard, and L. Goatcher. 1989. Bacteria Associated with Crown and Root Rot of Sainfoin in Southern Alberta. Can. J. Plant Sci. 69(1):5-8.

Hwang, S. F., R. J. Howard, and E. R. Moskaluk. 1989. Crown and Root Rot of Alfalfa in Southern Alberta. Can. Plant Dis. Surv. 69(1):9-11.

Major, D. J., R. E. Blackshaw, B. I. Roth, R. Gaudiel. 1990. The potential of corn as a New Dryland Crop for the Northern Great Plains. Submitted to J. of Production Agriculture.

McKenzie, R. C., W. Chomistek and N. F. Clark. 1989. The Conversion of Electromagnetic Induction Readings to Saturated Paste Extract Values for Different Soil Temperatures and Textures and Moisture Conditions. Can. J. Soil Sci. 69:25-32.

Pluim, R. A., J. P. Tewari, N. R. Knowles, and R. J. Howard. 1989. Survey for Dieback and Canker Disease of Saskatoon Caused by *Cytospora* sp. Can. Plant Dis. Surv. 69(1):83.

Wallace, D., R. Gaudiel, et. al. 1989. Analysis at Fifty-two Site Seasons of Genetically Controlled Correlations Among the Yield-system Output Traits of Bean (*Phaseolus vulgaris* L.) submitted to Science or as a Research Report of Cornell University.

Williams, P. and R. C. McKenzie, 1989. The Influence of Irrigation on Wheat Strength. Abs. #172. Cereal Foods World. Vol. 33:665

SELECTED REPORTS

Beasley, B., D. J. Major and R. Gaudiel. 1989. 1989 Corn Hybrid Trials. Alberta Corn Committee.

Esau, R. 1989. Expert Committee on Weeds (Western Canada Section) Minutes of Annual Meeting held at Winnipeg, Manitoba, November 29, 30 and Dec. 1, 1989.

Esau, R. 1989. Weed Control in Herbs and Spices. Internal Progress Report, ASCHRC. March.

Hausher, L. (Editor) 1989. 1988 Annual Report, Alberta Special Crops and Horticultural Research Center, Brooks.

Holley, J. D. 1989. Potato Diseases. Chapter 9 in Guidelines for the Control of Plant Diseases in Western Canada. Western Comm. Plant Dis. Control.

Howard, R. J. and B. R. Shaw. 1989. Report on the In-Service Workshop on Virus Diseases of Cereal Crops. Lethbridge, AB. ASCHRC Pamphlet 89-18. 22 pp.

Najda, H. G. 1989. Cereals and Oilseeds Varietal Tests at Acadia Valley. Supplementary Project Report. 1988. Chinook Applied Research Association, Oyen.

Schaupmeyer, C. 1989. Some Thoughts on Potato Planting Management. Alberta Potato Marketing Board, Research Notes. February.

Schaupmeyer, C. 1989. Proper Procedure Essential for Useful Tissue Sample Results. Alberta Potato Marketing Board, Research Notes. June.

PRESENTATIONS

Presented at Professional Meetings

Crowe, N. L., M. Dench, and J. Hironaka. 1989. Development and Evaluation of a Carrot Leather Snack Food. Annual Conference of the Canadian Institute of Food Science and Technology, Quebec City, PQ. June.

Crowe, N. L. 1989. Food Processing at the Alberta Special Crops and Horticultural Research Center. Seminar for the Department of Applied Microbiology and Food Science, University of Saskatchewan, SK. October.

Esau, R., B. Kruger. 1989. Use of a Portable Tandy Computer As a Field Notebook. Poster presented at Plant Pathology Society of Alberta, Annual Meeting. Brooks. November.

Gaudiel, R. 1989. Special Research Activities in 1989. Western Expert Committee on Grain Breeding. Ottawa. February.

Heaney, D. J., E. D. Solberg, R. C. McKenzie, and L. Kryzanowski. 1989. Nitrate Leaching in Alberta. A summary of Recent Data to Agriculture Institute of Canada. Montreal. June.

Holley, J. D. 1989. Resistance in the Potato Silver Scurf Pathogen *Helminthosporium solani* to the Benzimidazole Fungicide, Thiabendazole. Plant Pathology Society of Alberta. Brooks. November.

Howard, R. J. 1989. Research on Verticillium Wilt of Alfalfa. Special Seminar, Dept. Plant Science, Univ. Alberta. Edmonton. April.

Howard, R. J. 1989. Interiorscape Plant Disease Situation Report and Research Update. 14th Ann. Mtg., West. Comm. Plant Dis. Control. Winnipeg. October.

Kaminski, D. A. 1989. Disease Situation Report: Shade Trees and Shelterbelts. Annual Meeting of the western Committee on Plant Disease Control. Winnipeg. October.

McKenzie, R. C. 1989. Soil Salinity as Measured by Several Methods and the Growth of Wheat. Agriculture Centre Seminar. January. Lethbridge.

McKenzie, R. C. 1989. Soil and Water Management of HY 320 Wheat to Prairie Spring Wheat Research Review meeting ERDA. February. Saskatoon.

McKenzie, R. C., D. J. Heaney, L. Andruchow, and P. Wolyshyn. 1989. Reserves of Nitrogen at Depth in Cultivated Soils. To American Society of Agronomy Meeting. Las Vegas, NV. October.

Pluim, R. A., N. R. Knowles, J. P. Tewari, and R. J. Howard. 1989. Early Dieback and Canker Disease of Saskatoon. 86th Ann. Mtg., Amer. Soc. Hort. Sci. Tulsa, OK. August.

Pluim, R. A., N. R. Knowles, J. P. Tewari, and R. J. Howard. 1989. Early Dieback and Canker Disease of Saskatoon. 10th Ann. Mtg., Plant Path. Soc. Alta. Brooks. November.

Presented to Advisory Committees

Butt, J. A. 1989. Progress Report of ASCHRC Extension and Research Activities. Protected Crops Advisory Subcommittee. Red Deer. November.

Gaudiel, R. 1989. Field Pea Research Conducted by the ASCHRC. Alberta Pulses Crops Advisory Subcommittee. Lethbridge. December.

Gaudiel, R. 1989. Results of Some Special Crops Trials Conducted by ASCHRC in 1989. Alberta Special Crops Advisory Subcommittee. Lethbridge. December.

Howard, R. J., E. R. Moskaluk, B. T. Roth and E. L. Matthew. 1989. Studies on Seedling Blight of Safflower. Alberta Special Crops Advisory Committee. Lethbridge. December.

McKenzie, R. C. 1989. Irrigated Pea Research at Brooks to Alberta Pulse Crops Advisory Subcommittee Meeting. Lethbridge. December

McKenzie, R. C. 1989. Groundwater Nitrogen Research to Alberta Soil Fertility Subcommittee Meeting. Edmonton. November

McKenzie, R. C. 1989. Sources of Funds within Alberta Agriculture for Soil and Environmental Research to Environmental Subcommittee of Alberta Horticultural Advisory Committee. Brooks. November

Najda, H. G. 1989. Perennial Varieties Subcommittee Report. Alberta Forage Advisory Committee. Edmonton. November.

Presented at Growers' and Agri-Business Meetings and Courses

Butt, J. A. 1989. Results of ASCHRC Powdery Mildew Trial/Bedding Plant and Growth Regulator Trial. Alberta Horticulture Congress. Edmonton.

Crowe, N. L. 1989. Current Food Research on Fruit at ASCHRC. Fruit Growers' Society of Alberta, Edmonton. February.

Crowe, N. L. 1989. Fruit Leather, Pie Fillings, Jellies and Jams. Hort Week, Olds College, Olds. July.

Crowe, N. L. 1989. Discoloration in Prepeeled Potatoes. A research poster presented at the ASCHRC Potato Research Field Day, Brooks. August.

Crowe, N. L. and J. D. Holley. 1989. New Facilities for Food Processing and Post Harvest. A poster presented at the ASCHRC Potato Research Field Day, Brooks. August.

Crowe, N. L. 1989. Developing a Dried Carrot Product. Commercial Food Drying Workshop sponsored by the Saskatchewan FOODTALK Extension Program, Saskatoon, SK. October.

*Esau, R. 1989. Broadleaf Weed Seedling Identification and Weed Control in Lentils. Irrigated Crop Protection Workshop. Lethbridge. July.

Esau, R. 1989. Finding a Balance Between Economic Weed Control and Human Safety and Environmental Protection. In Report Proceedings 1989 Annual Potato Industry Conference. November.

Esau, R. Weed Control Research for Potatoes. Poster for Potato Research Field Day. Brooks. August.

*Esau, R. Update - Weed Control in Vegetable Crops. Vegetable Production Seminar. Edmonton. February.

*Esau, R. Weed Control in Lawns, Gardens and Ornamental Plantings. Herbicide Workshop. Edmonton. March.

Gaudiel, R. 1989. Sunflower Hybrids. Sunflower School. Taber. February.

*Hausher, L. G. 1989. Strawberry/Raspberry/Saskatoon Production and Marketing. Commercial Berry Crop Production Schools. Grande Prairie, Edmonton, Red Deer, Taber. January-February.

*Hausher, L. G. 1989. Direct Marketing of Berry Crops. AMGA Marketing/Promotional Seminar. Edmonton. February.

*Hausher, L. G. 1989. Establishing a Saskatoon Orchard, Marketing Saskatoons. Saskatoon Seminar. Winnipeg. March.

*Hausher, L. G. 1989. Day-Neutral Strawberries. Raspberry Trial Update. Alberta Horticultural Congress. Edmonton. November.

*Hausher, L. G. 1989. Marketing Small Fruit in Alberta. Small Fruit Research in Alberta. Horticultural Industry Days. Winnipeg. November.

---

* abstract not available.

Holley, J. D. 1989. Diseases in Woody Ornamentals. Horticultural Maintenance Seminar Pruning Course. Brooks. March.

Holley, J. D. 1989. Identification of White Knot Disorder on Potato. York Farms Potato Seminar. Taber. March.

Holley, J. D. 1989. Synopsis of Dutch Elm Disease Situation in Alberta. Dutch Elm Disease Action Committee Meeting. April. Edmonton.

Holley, J. D. 1989. Recognition of bacterial ring rot and other similar diseases in the field. Training Seminar for Potato Inspectors. Brooks. August.

Holley, J. D. 1989. Synopsis of the Ring Rot Infestation at ASCHRC. Alberta Potato Marketing Board Annual Meeting. Calgary. November.

Howard, R. J. 1989. Diseases of Greenhouse Ornamentals and Their Management. Pesticide Applicator Training Seminar. Olds. January.

Howard, R. J. 1989. Update on Field Crop Diseases. Disease and Insect Survey Committee (DISC). Warner. January.

Howard, R. J. 1989. Alfalfa Disease Concerns. Top Yield Alfalfa Seminar. Seven Persons. February.

Howard, R. J. 1989. Diseases of Alfalfa. Alfalfa Production Seminar, Lethbridge. February.

Howard, R. J. 1989. Head Smut of Corn and its Control. Alberta Corn School. Burdett. February.

Howard, R. J. 1989. Diseases of Field Peas. Pulse Growers Seminar. March. Morinville.

Howard, R. J. 1989. Overview of the Importance of Virus Diseases on Cereal Crops in Southern Alberta. In-Service Workshop on Virus Diseases of Cereal Crops. Lethbridge. March.

Howard, R. J. 1989. Management of Plant Diseases. Irrigated Crop Protection Workshop. Lethbridge. July.

Howard, R. J. 1989. Disease Management on Greenhouse Vegetables. Southern Alberta Greenhouse Growers' Meeting. Redcliff. December.

*Kaminski, D. A. 1989. Fundamentals of Plant Pathology and Diagnosing Diseases of Greenhouse Ornamentals. Pesticide Applicators Course. Olds. January.

---

* abstract not available.

*Kaminski, D. A. 1989. Diseases of Canola. Brooks Area Growers' Forum. Brooks. March.

*Kaminski, D. A. 1989. Diseases of Trees and Shrubs. Calgary Horticulture Society. Calgary. March.

*Kaminski, D. A. 1989. Fundamentals of Plant Pathology and Diagnosing Field Crop Diseases. Irrigated Crops Workshop. Lethbridge. July.

*Kaminski, D. A. 1989. Summary of the ASCHRC Regional Crops Laboratory's Diagnoses from Samples of Canola Suspected as Infected with Blackleg. Blackleg of Canola Response Plan Implementation Evaluation Meeting. Vegreville. October.

Kaminski, D. A. 1989. Plant Diseases Concerns in Southern Alberta. Interdisciplinary Crop Meeting. Edmonton. December.

*Kaminski, D. A. 1989. Diseases and Insects of Cereals and Canola. Willow Creek Crop Production Club. Claresholm. December.

McKenzie, R. C. 1989. Growing Winter Wheat on Standing Stubble, a Three Year Progress Report to Region II and III, On Farm Demonstrations Review Committee. Airdrie and Red Deer. February.

*McKenzie, R. C. 1989. ASCHRC Seminar Series. Egypt and Canada's Foreign Aid. March. Brooks.

McKenzie, R. C. 1989. Soil and Water Salinity - What they are and how they affect crops. CIDA International Drainage Course. Lethbridge. May.

McKenzie, R. C. 1989. Soil Salinity - What it is and What can be Done About it. Brooks Rotary Club. November.

McKenzie. R. C. 1989. Soil Salinity and Trees to Landscape and Nursery Trades Association. Red Deer. November.

Najda, H. G. 1989. Irrigated Alfalfa Forage Production. Alfalfa Forage Production Workshop. Enchant. March.

Schaupmeyer, C. 1988. Potato Planting Management, York Farms Workshop. March. Taber.

Tellier, A. J. 1989. Control of Western Flower Thrips with a Native Predator *Orius tristicolor* (White). Commercial Greenhouse Growers' Meeting. December. Redcliff.

---

* abstract not available.

*Tellier, A. J. 1989. Shelterbelt Pest Management. Shelterbelt Workshop. Coutts. November.

*Tellier, A. J. 1989. I.P.M. in Greenhouses and Woody Ornamentals Pest Management. Olds College, Olds. November.

*Tellier, A. J. and J. D. Holley. 1989. Dutch Elm Disease: Keeping Alberta Free of the Disease. Workshops at Canada Customs Stations at Wild Horse, Aden, Coutts, Del Bonita, Carway, and Chief Mountain. June.

*Tellier, A. J. and J. D. Holley. 1989. Dutch Elm Disease Monitoring and the Use of Pheromone Traps. Seminar for District Agriculturists and City Parks staff. Brooks. May.

Tellier, A. J. 1989. Results of the Dutch Elm Disease Vector Surveillance Program, 1989. Report to the Dutch Elm Disease Action Committee. Edmonton. April.

*Tellier, A. J. 1989. Field Vegetable Pest Management. Commercial Vegetable Growers' Course. Taber. March.

*Tellier, A. J. 1989. Woody Ornamentals Pest Identification and Management. ASCHRC Pruning Course. Brooks. March.

*Tellier, A. J. 1989. Current Pest Situations for Nurseries in Alberta. LANTA Growers Group Meetings. Airdrie and Calgary. February.

EXTENSION BULLETINS, FACTSHEETS, AND PAMPHLETS

Beasley, B., R. Gaudiel, B. Roth, D. Major. 1989. 1990 Hybrid Recommendation List. Alberta Corn Committee Publication.

Casement, E. B., M. Eliason, A. W. Goettel, F. M. Green, J. C. Hermans, W. W. Jackson, R. Nelson, R. C. McKenzie, E. L. Treffrey and W. Yarish. 1989. Cropping and Conservation. Alberta Agriculture. 31 pp.

Holley, J. D. 1989. Potato Diseases Factsheet. Alberta Potato Marketing Board Publication. Calgary, AB.

Howard, R. J. and E. Cahane. 1989. User Documentation for the Fungicide and Fumigant Information Retrieval System (FFIRS), Version 3.1. ASCHRC Pamphlet 89-19. 9 pp.

Mathers, H. M. and N. Seymour. 1989. Forever Green Pinetum. ASCHRC Pamphlet 89-12.

---

* abstract not available.

Mathers, H. M. 1989. The Golden Prairie Arboretum. ASCHRC Pamphlet 89-1. 23 pp.

Najda, H. G. (ed.). 1989. Varieties of Perennial Hay and Pasture Crops for Alberta. AFAC. Revised. Agdex 120/32.

Najda, H. G. 1989. Grass Seed Production Under Irrigation. Agdex 127/15-4. 7 pp.

PERIODICALS AND NEWSLETTERS

Chung, C., and H. M. Mathers. 1990. Revolutionary Oklahoma Technique Produces Shade Trees in Two Years. *Prairie Landscape Magazine*. Vol. (13)1:Jan.-Feb.

Crowe, N. L. 1989. Food Processing and Quality Evaluation Program - A Summary of Research on the 1988 Crop. *The Fruit Grower*, Fall, 1989.

Esau, R. 1989. Current Weed Research for Nursery Stock. *The Prairie Arborist*. September, 1989.

Hausher, L. G. 1989. *Fruit Facts*. ASCHRC. Monthly

Hausher, L. G. 1989. *The Fruit Grower*. Tri-Monthly.

Howard, R. J. 1989. Seedling Blight and Root Rot of Field Beans and Peas. *Nukrop News* (Summer Edition):16.

Howard, R. J. 1989. Anthracnose: A New Fungal Disease of Lentils. *Nukrop News* (Summer Edition):16-17.

Kaminski, D. (ed.). 1989. *Crop Protection Newsletter* (Southern Alberta). Monthly.

Najda, H. G. (ed.). 1989. Perennial Hay and Pasture Crops in 1989 *Alberta Seed Guide*. Supplement to *Farm Light and Power*. February.

APPENDIX I. METEROLOGICAL REPORT

Summary of 1989 Weather Conditions

The first three months of 1989 had temperatures 3-6°C below normal, with sunshine hours 20-30 hours above long-term averages. It was extremely dry during November and December with precipitation amounts of 0.7 mm and 0.4 mm respectively.

The growing season began May 1 and ended September 10, a total of 133 days. The season was characterized by normal precipitation, temperature and sunshine. Total heat unit accumulation was 2408 corn heat units.

Table 4. Environmental data recorded at the Alberta Special Crops and Horticultural Research Center, Brooks, 1989.

	Temperature (°C)			Precipitation	Sunshine
	Maximum	Minimum	Mean	(mm)	(h)
January	7.7	-38.4	-10.1	30.7	112.1
February	7.2	-35.4	-14.7	7.4	152.8
March	11.0	-29.2	-6.6	9.7	169.4
April	24.6	-9.4	5.7	25.0	238.2
May	27.6	-0.2	11.3	46.2	253.3
June	32.1	4.9	16.7	41.4	309.2
July	24.0	7.1	20.5	10.7	337.2
August	32.2	6.3	17.8	51.8	217.6
September	28.7	-2.6	12.7	15.6	243.6
October	22.9	-8.1	6.7	4.2	188.8
November	15.7	-13.4	-0.5	0.7	89.3
December	11.6	-42.0	-7.2	0.4	61.2

APPENDIX II. TERMS OF REFERENCE ASCHRC ADVISORY COMMITTEE

PURPOSE

The ASCHRC Advisory Committee is a permanent committee established to be advisory to the ASCHRC Director.

MEMBERSHIP

Membership on the committee is by invitation, and includes representation from industry associations and associated organizations. Representation is by appointment through the association or by the Director, ASCHRC.

1. Industry Representatives - Grower Organizations

   - Landscape Alberta Nursery Trades Association
   - Alberta Greenhouse Growers Association
   - Alberta Vegetable Growers Marketing Board
   - Alberta Fresh Vegetable Marketing Board
   - Alberta Market Gardeners Association
   - Alberta Potato Marketing Board
   - Pulse Growers Association of Alberta
   - Flowers Canada - Alberta Region
   - Fruit Growers Society of Alberta
   - Red Hat Co-operative

2. Industry Representatives - Non-grower

   - Alberta Potato Processors
   - Horticultural Supply Specialists
   - Empress Foods Ltd.

3. Associated Organizations

   - University of Alberta - Plant Science
   - Agriculture Canada Research Station - Lethbridge
   - Alberta Agriculture Regional Director (Region I or II)
   - Alberta Tree Nursery and Horticulture Centre - Director
   - Field Crops Branch, Alberta Agriculture - Head
   - Director - Plant Industry Division

4. Community Representative

5. Director, ASCHRC

OBJECTIVES

1. The committee shall regularly review and critique ASCHRC programs.

2. The committee shall recommend new research and extension program initiatives; and assist in the establishment of priorities for existing programs.

3. The committee shall deal primarily with matters pertaining to ASCHRC research and extension programs, and not necessarily with broad industry related problems, e.g. marketing, except as they may influence program objectives.

MEMBERSHIP RESPONSIBILITY

1. To attend all meetings as scheduled, and to represent their area of interest from an overall industry point of view.

2. To provide input to meetings reflecting the needs of agency members and producers which they represent to ensure that they be addressed by the ASCHRC. Written submissions are preferred.

3. In regard to Committee Objective #1, members should attend regularly scheduled program reviews in their commodity area. (These reviews are planned biennially.)